

HNTB

Environmental Engineering

HOWARD NEEDLES TAMMEN & BERGENDOFF



Preserving Natural Resources

... through Environmental Engineering

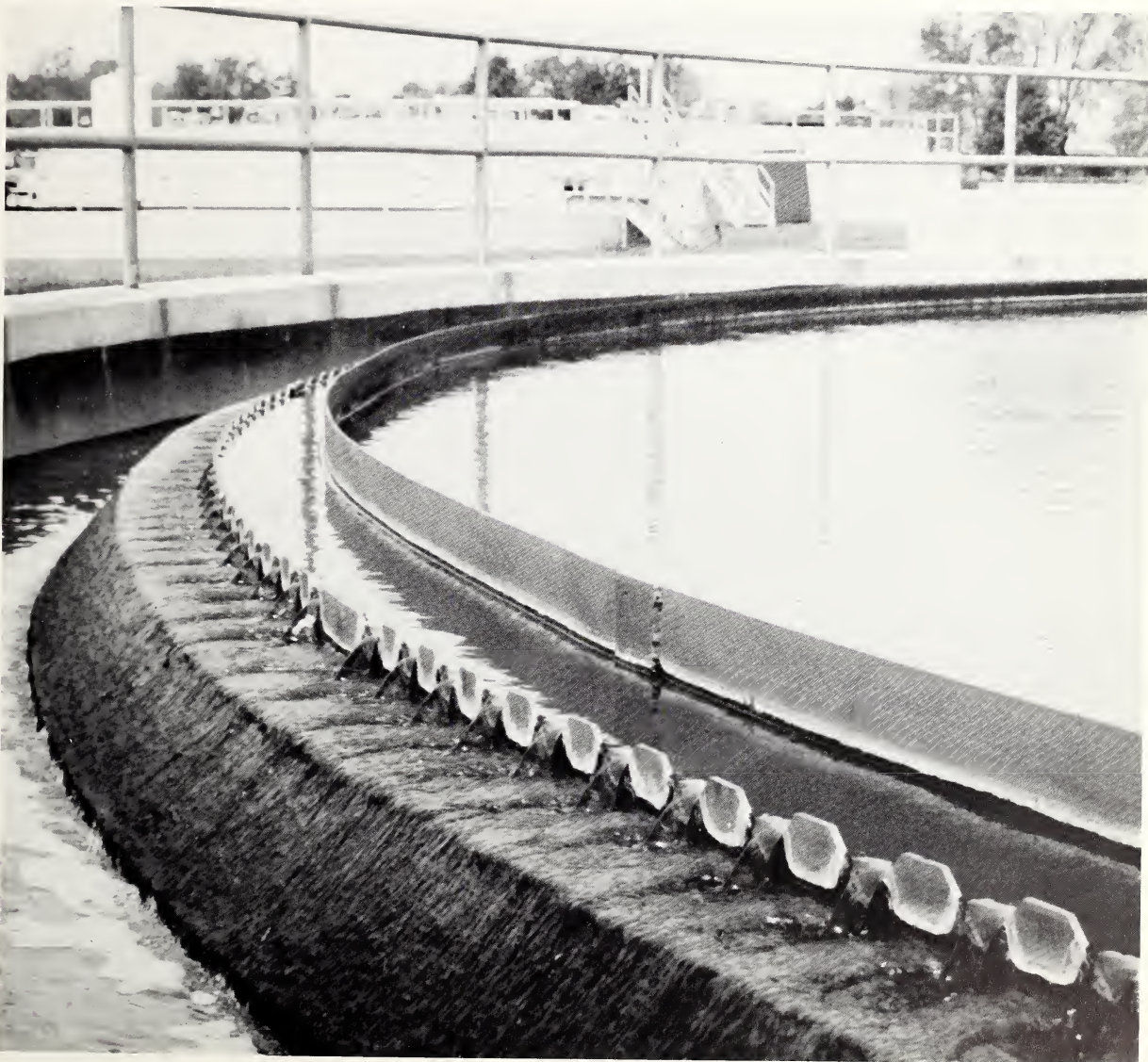
Community living produces concentrations of waste products which require treatment in order to protect the environment. Facilities to do so should in themselves be esthetically acceptable and economical to construct and operate. Such objectives are achieved by an environmental engineering team of skilled professionals. Work routinely undertaken by these men and women includes the design of wastewater collection and treatment facilities, water supply and distribution systems, dams, reservoirs, etc. These engineers and planners are competent in developing river basin studies, preparing environmental assessments, controlling air and noise pollution, and disposing of solid wastes.

HNTB has the expertise to provide total environmental engineering services, carefully considering all of the following factors affecting design:

- | | |
|----------------------------------|--|
| Impact on nature — | The physical, social, and economic effects of alternate plans on people and their surroundings must be measured. |
| Effect on future growth — | How each alternate either encourages or limits possible growth needs to be evaluated. |
| Financial issues — | The economic impact of various alternative plans is an essential design ingredient. Both capital expenditure and operating expenses must be considered. |
| Public and government interest — | Projects must be designed not only to best serve the interest of the public, but to meet criteria of the various governmental agencies whose approval is necessary if federal funding is sought. |



Right: Wastewater flowing out of the Speedway, Indiana secondary clarifier is almost ready for discharging into Eagle Creek.



Wastewater Collection



Since each community has differing collection problems, the condition of existing systems must be thoroughly investigated and evaluated by engineers experienced in designing the most practical and economical solutions. In older systems, storm water is often combined with sanitary waste in the same "combined" sewer. Problems with overflows from these systems and excessive flows being transported to treatment facilities, have prompted engineers to currently plan and construct separate sanitary sewers (draining to treatment) and separate storm sewers (draining to open water courses).

In the evaluation process, HNTB engineers utilize various techniques such as infiltration-inflow studies, closed-circuit television inspections, and mathematical modeling.

Sanitary Sewers

The firm has been responsible for the design and construction of millions of feet of new sewers. Materials selected and construction methods depend on soil conditions, topography, and land use of the surrounding area.

Sanitary systems range in size from small, 8-inch local sewers, to large diameter trunk or arterial collectors. They may be oval, elliptical, or rectangular; prefabricated or monolithic; and installed in trench, tunnel, or aerial sections.

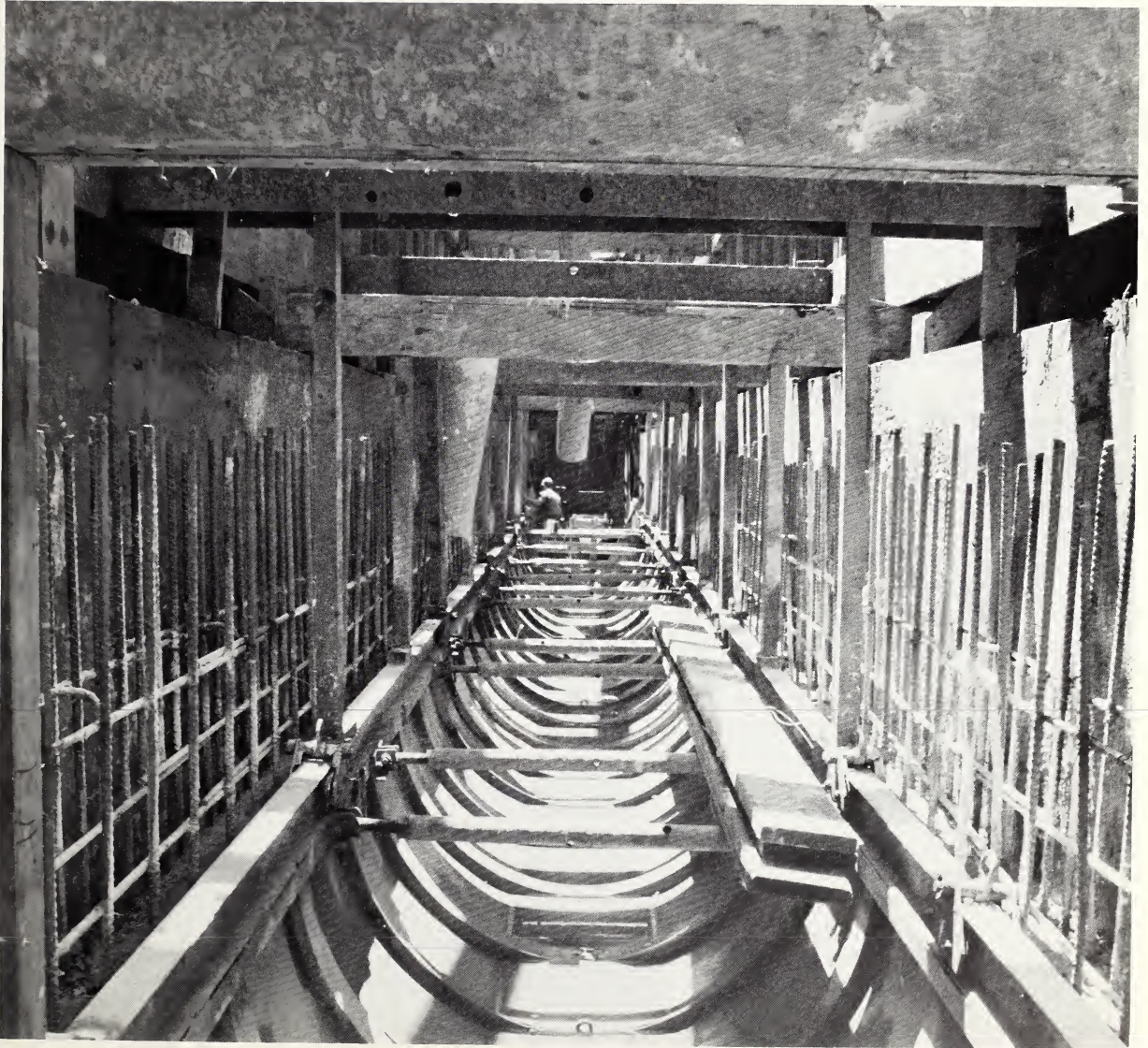
Storm Drainage

Hydrologic data for drainage areas under study is collected as the backbone for the design of storm drainage facilities. Storm water drainage facilities may take the form of a closed conduit network of storm sewers or open ditches and culverts.

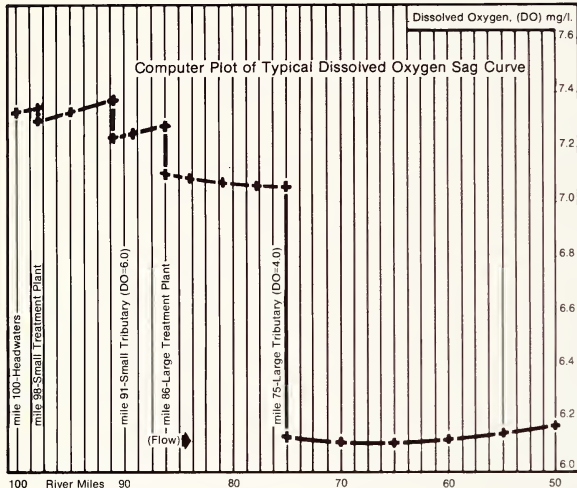
Consideration is given to storm water treatment, retention, or impoundment. Possible designs are tested for capacity, feasibility, land use compatibility, and environmental impact.

Left: Retention basin set in Maplewood, Minnesota park follows natural depression to form scenic pool occupying only 6 of park's 23 acres.

Right: Placed invert of 66-inch diameter cast-in-place interceptor is part of the Port Richmond Water Pollution Control Project in the City of New York.



Wastewater Treatment



Current EPA regulations require that all wastewater treatment plants be modified to provide complete treatment. Advanced treatment will be required and supplemented by nutrient removal if local stream conditions so warrant.

Treatment plants having various degrees of sophistication and meeting the varying requirements of state and federal agencies have been designed by HNTB and are now in operation.

Before developing design alternatives and making a cost-effective analysis, HNTB thoroughly explores the treatability of the wastes, determines the necessary capacity of treatment facilities and the need for future expansion, and incorporates their findings into the final design. Facility plans, equitable cost recovery studies, operation and maintenance manuals, and operator training programs are also furnished.

The firm is experienced in providing practical assistance to a municipality in preparing and submitting applications for federal grants and state aid and in the development of financial prospectuses.

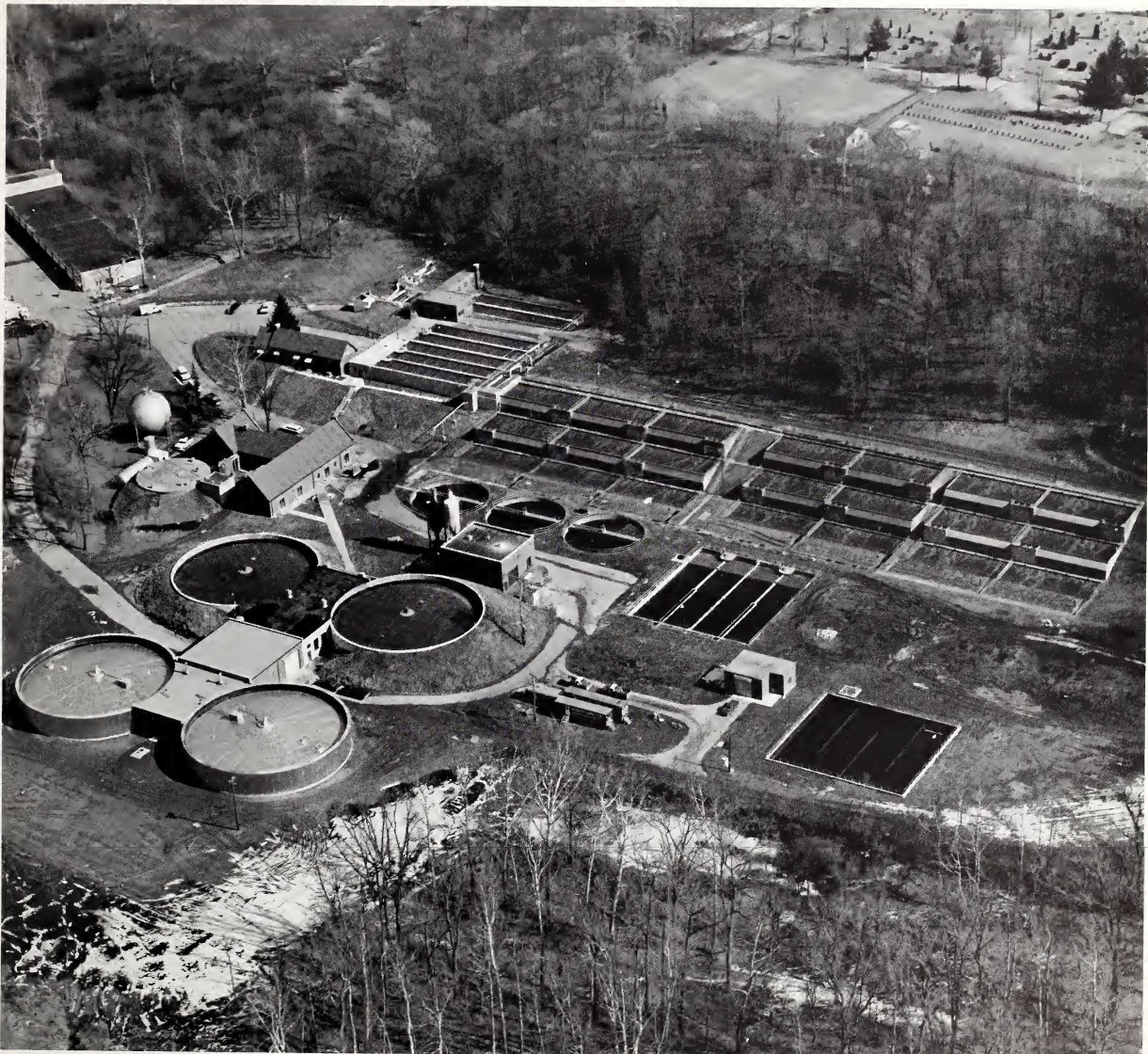
Industrial Wastes

HNTB has experience in the treatment of a wide variety of industrial wastes, including those from paper manufacturing, canning, plating, meat packing, foundry, pharmaceutical, dairy, distillery, and fiberglass manufacturers. Industrial waste derivatives from the production of paints, pesticides, oils, solvents, acids, caustics, and biologicals have been treated.

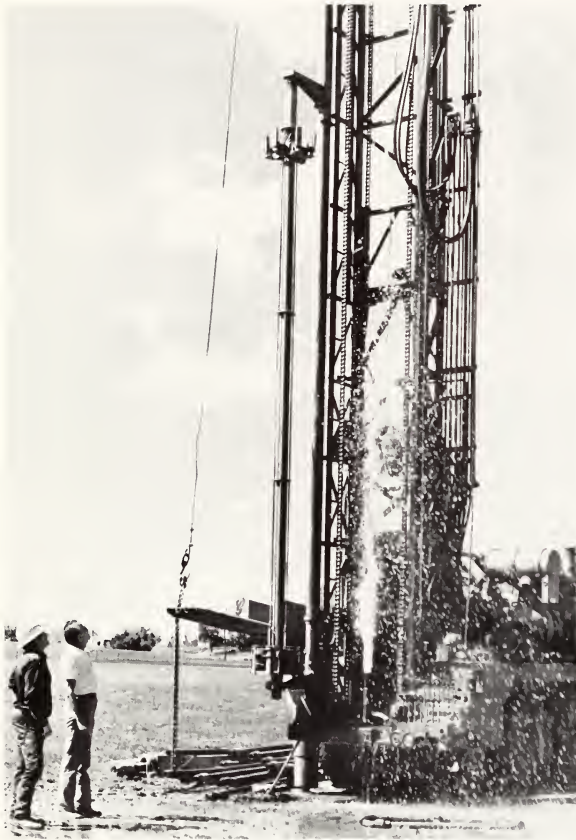
Industrial waste treatment or reclamation facilities have been designed to produce effluents acceptable for discharge either into nearby receiving streams or into available municipal systems. Inventory and sampling programs, followed by feasibility and economic studies, are generally made prior to design and construction.

Left: The supply of dissolved oxygen (DO) in a water course is a significant indication of the extent of pollution. This prototype chart traces measured DO levels along a receiving stream at points into which various pollution and siltation inflows have been located.

Right: Aerial of Richmond, Indiana wastewater treatment plant — additions made since 1951.



Waterworks Design



Source of Supply

Proven availability of an adequate water supply is the key to waterworks planning. Initially, HNTB engineers and planners determine a community's present and future need for potable water. The existing residential-commercial-industrial development is studied and the local intent or potential to maintain or modify the mix is investigated. Available ground or surface raw water sources are then thoroughly evaluated, and all cost-effective alternatives are developed, based on reliability, quantity, quality, treatability, and proximity. Consideration is also given to the potentials of a regional system.

Treatment Plants

Characteristics of the selected source and the treatment necessary to make the water potable are thoroughly analyzed by HNTB specialists. A treatment process is then selected to remove objectionable contaminants, such as turbidity, gases, color, tastes, and odors and to convert raw water to a potable finished product.

The principal objective is to design a functional water treatment works, incorporating ease and economy of operation with attractive appearance.

Distribution Systems

Routes for water transmission, distribution, and reinforcing mains are frequently dictated by the location of city streets and the presence or absence of other conflicting utility lines. Elevated storage tanks are located in the system to provide uniform pressure and emergency supply. Hydrants are selected and spaced for proper fire protection, and on-line computer facilities are used extensively for system analysis.

Left: Drilling of test wells at Riverton, Wyoming
to obtain new source of water supply.

Right: 10 MGD water treatment plant in
Anderson, Indiana.



Stream and River Basin Studies

Streams and river basins are studied to evaluate divergent problems such as: (1) allowable limitations on wastewaters discharged to these watercourses, (2) flood control requirements, and (3) navigation requirements.

HNTB has completed studies of several major river basins. The staff is experienced in data collection, hydrologic analyses, mathematical modeling, load allocation studies, and the planning process necessary to comply with government agency regulations.

Basin studies for wastewater load allocation purposes are an important step basic to EPA and State Water Quality planning. HNTB has had major input into such studies.

Dams & Reservoirs

Rivers are dammed and water impounded for purposes of water supply, irrigation, flood prevention, hydroelectric power, and recreation.

Dam and reservoir projects require various HNTB disciplines such as engineering, meteorological, hydrologic-hydraulic, feasibility, and benefit/cost studies; investigations of sites and soil mechanics; design of dam embankments, spillways, stilling basins, docks, and roads; preparation of topographic base maps as well as plans and specifications; and construction inspection. HNTB also acts as general consultant for existing dams and makes annual inspections to assure they are operating properly and in accordance with design standards.



Left: Damage caused by collapse of unstable coal-waste dam in Buffalo Creek, West Virginia.

Right: Reservoir gate structure renovation in Wheatland, Wyoming controls snow-melt water supply for irrigation.



Disposal of Solid Wastes

Collection and disposal of solid wastes has become an increasing problem. When sufficient undeveloped land is available at a reasonable cost, sanitary landfill is probably the most practical solution. For urban areas where land is at a premium, incineration may be the answer, but only if it meets air pollution standards. Recycling, reuse, reclaiming, or converting the waste into a salable product must also be considered in the development of a total plan.

HNTB has designed many sanitary landfill operations and has prepared economic feasibility studies of solid waste disposal on a local or county-wide basis. The firm can evaluate solid waste reclamation, power conversion systems, and product marketing.

Control of Air and Noise Pollution

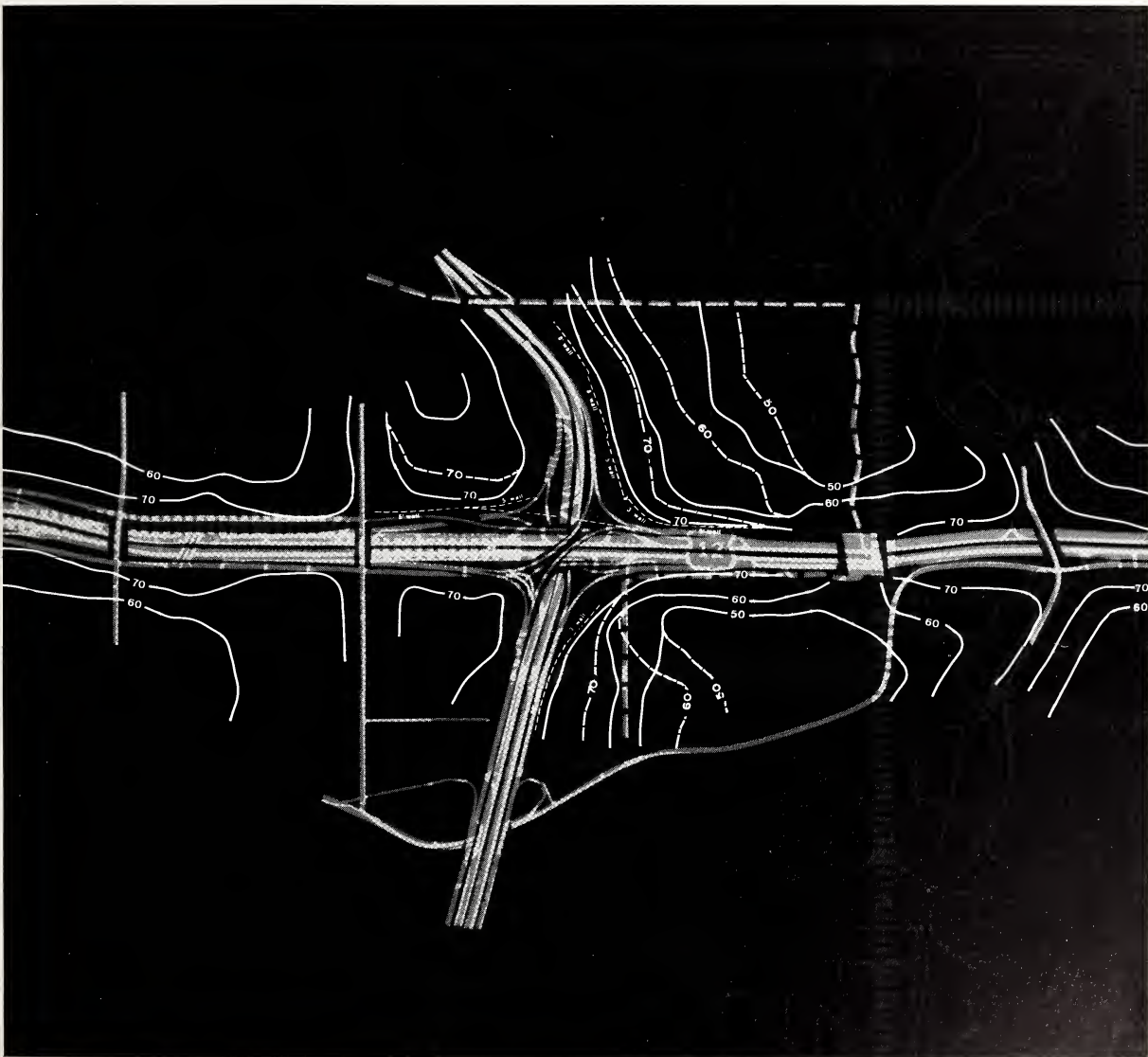
In order to meet ambient air quality standards and acceptable noise levels established by federal regulations, HNTB offers counsel on a wide variety of air and noise pollution problems.

Industrial stack discharges are sampled and evaluated, and performance standards are established for air pollution abatement systems. Municipalities use the firm's surveys and reports as the basis for tailor-made air pollution abatement ordinances. Noise impacts are forecast and intensity reduced to acceptable levels by special acoustical devices or careful design of emission stacks.



Left: Industrial stack emission evaluations, analyses, and design of pollution control systems are part of HNTB's multidisciplinary capabilities.

Right: Adverse highway noise (measured in decibels) frequently requires study.



Environmental Assessments

The National Environmental Policy Act of 1969 requires that all EPA funded projects be subjected to an environmental assessment and/or environmental impact statement. HNTB has extensive experience in this type of analysis and resource planning.

A typical environmental study consists of:

- Inventory of pertinent data available
- Determination of criteria for evaluating alternate solutions
- Design and carrying out of appropriate supplemental studies
- Identification and preliminary evaluation of possible alternatives
- Comprehensive evaluation of those selected as feasible
- Development of conclusions and recommendations, presented in a suitable format

Public information and citizen participation programs are part of the process. HNTB involves the community in the planning of projects from the very beginning, both to obtain input and to avoid misinformed opposition.

HNTB's Department of Environmental Quality and Conservation is entirely devoted to the preparation of environmental assessments and impact statements, and staff members have expertise in geography, terrestrial and aquatic biology, environmental physics, plant ecology, environmental economics and engineering, and urban, regional, and transportation planning. In addition to impact statements, science writers and editors in the department prepare technical reports and newsletters.

Design Team

HNTB employs a multi-discipline design team approach to the solution of today's complex environmental problems. Its professional philosophy and practice are firmly committed to the concept of total design which entails, even for the smallest project, the coordination and integration of many diverse and specialized skills. Project management and design teams are specifically organized to fulfill each client's requirements.

The staff includes sanitary engineers, planners, architects, economists and statisticians, mechanical, electrical and structural engineers, all supported effectively by other technical and clerical personnel. Availability of a full complement of professionals and technicians within a single consulting firm facilitates the decision-making process, reduces costs, eliminates duplication of effort, and produces unified results in a minimum of time. A 1973 merger with Henry B. Steeg & Associates, Inc. enhanced the firm's capabilities in environmental engineering.

HNTB has been privileged to serve clients in many categories and has demonstrated the capability to meet the engineering requirements of towns, cities, counties, state and federal agencies, industries, land developers, investor-owned utilities, and commercial and private interests.



Left: Public presentation of data gathered for an environmental impact statement on maintenance dredging the Mississippi River channel attracted many concerned individuals.

Right: A broad range of specialists in environmental and technical disciplines working together as a trained team can solve complex problems.



Selected Environmental Engineering Projects

Wastewater Collection

Sanitary Sewers

Staten Island Interceptor
New York City

Interceptor Sewers
Indianapolis, Indiana

Collection System
Manchester, New Hampshire

Wastewater Study
Regional Airport
Lisbon, Portugal

Knickerbocker Avenue Sewer
Brooklyn, New York

Sewer Master Plan
Buffalo Creek, West Virginia

Collection System
Muncie, Indiana

Collection System
Taycheedah San. Dist. No. 1
Fond du Lac Co., Wisconsin

Storm Drainage

Sewers
Manchester, New Hampshire

Expressway System Drainage
Kansas City

Sewers and Retention Basin
Fort Wayne, Indiana

Sewers and Overflow
Treatment, Indianapolis

Comprehensive Plan
Orlando, Florida

Retention Basin
Maplewood, Minnesota

Sewers
Richmond, Virginia

Wastewater Disposal

Treatment Plant
Carrollwood Village
Tampa, Florida

Plant Expansion
South Gate
Sarasota, Florida

Treatment Plant
Evansville, Indiana

Advanced Treatment Plant
DeWitt Township
Clinton County, Michigan

Treatment Plant
Rhinelander, Wisconsin

Industrial Wastes

Disposal of Phenols
PPG Industries, Fiberglass
Manufacture, Shelbyville, Ind.

Disposal of Whitewater
Container Corp. of America
Paper Manufacturing
Wabash, Indiana

Disposal of Milk Products
Wastes, County Line Cheese
Co., Division of Beatrice Foods
Auburn, Indiana

Disposal of Oils
Ford Motor Company
Indianapolis

Disposal of Acids and Cyanide
Indiana Steel & Wire Co.
Muncie, Indiana

Pre-treatment of Creosote and
Oil Wastes, Moss-American
Inc., Milwaukee

Disposal of Metals and Soluble
Oils, Chrysler Corporation
Electrical Parts Plant
Indianapolis

Waterworks Design

Supply, Treatment, Distribu-
tion, Storage
Anderson, Indiana

Supply, Distribution and
Transmission Mains
Cape Coral, Florida

Water Supply
Aton, New Hampshire

Supply, Treatment, Distribu-
tion, and Storage
Speedway, Indiana

Supply and Treatment
Barefoot Bay, Florida

Cooling Water Supply and
Recycling (Detroit-Diesel-
Allison,) Division of General
Motors, Indianapolis

Water Supply Study
Rawlins, Wyoming

Water Master Plan
Treatment and Distribution
Buffalo Creek, West Virginia

Stream and River Basin Studies

Water Resource Projects (15)
U.S. Army Corps of Engineers
Chicago

Water Supply Valuation Study
Norfolk and Virginia Beach
Virginia

Nashua Water Quality Plan
Southern New Hampshire

Water Quality Management
Planning, State of Indiana

Load Allocation Study
(Fox River (Illinois))
State of Wisconsin

Crow Creek Flood Control
Study, Cheyenne, Wyoming

Water Resources, Use
Benefit Study,
Roanoke, Virginia

Charles River Flow Study
Franklin, Massachusetts

Flood Protection
Delaware River
Matamoras, Pennsylvania

Alton Bay Pollution Abatement
Study, Control of Algae
Alton, New Hampshire

Dams and Reservoirs

Terror Lake Dam
Kodiak Island, Alaska

Gordon Pittock Dam
Woodstock, Ontario

Lake Wildwood
Varna, Illinois

Lake Winnebago
Cass County, Missouri

Holiday Lakes
Oskaloosa, Kansas

Lehman Dam
Delhi, Ontario

Control of Air and Noise Pollution

Air Pollution Abatement
Keene Corporation
Huntington, Indiana

Carbon Monoxide Control
Statehouse Garage
Columbus, Ohio

Control of Poultry Odors
Rose Acre Farms
Seymour, Indiana

Air Pollution Abatement
Kieffer Paper Mills
Brownstown, Indiana

Noise Impact Study
Guthrie Avenue Viaduct
Des Moines, Iowa

Aircraft Noise Study
Everglades National Park
Regional Airport Site Selection
South Florida

Airport Noise Forecast
Miami, Florida

Noise Impact Study
I-394
Minneapolis, Minnesota

Disposal of Solid Wastes

Study, Design and Manage-
ment, Jasper, Indiana

Sanitary Landfill Design
Universal Services, Inc.
Kokomo, Indiana

Twin Cities Metropolitan
Area Solid Waste Resource
Recovery Analysis, Min-
neapolis-St. Paul, Minnesota

Solid Waste Study
Regional Airport
Lisbon, Portugal

Environmental Assessments

Spoil Disposal
Conneaut Harbor, Ohio

Great Adventure Amusement
Park,
Ocean County, New Jersey

I-215 Southeast Belt Route
Salt Lake City, Utah

Heliport Study
Washington, D. C.

Gov. A.E. Driscoll Expressway
South Central New Jersey

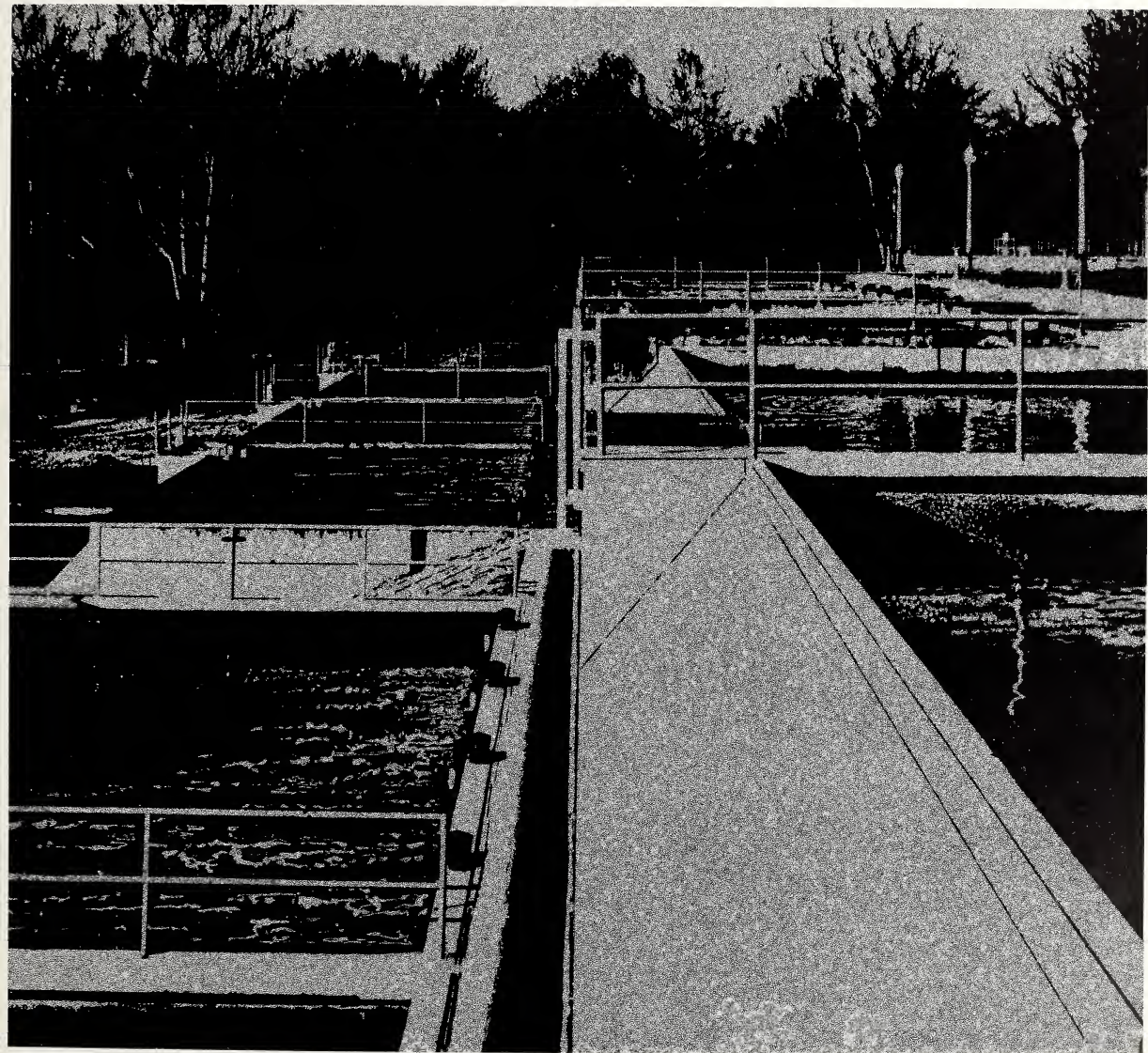
I-66 Transportation Alternates
Study, Fairfax-Arlington, Va.

Upper Mississippi River
314 Miles of Maintenance
Dredging and Disposal

HNTB

Environmental Engineering

HOWARD NEEDLES TAMMEN & BERGENDOFF



Environmental Engineering

Because each of its 27 offices is autonomous, HNTB consulting engineers are able to provide clients throughout the U.S. with local management of projects, augmented by expertise of specialists including architects, planners, and technicians as needed from other offices. The 1973 merger with Henry B. Steeg & Associates further broadened the firm's capabilities, especially in environmental engineering as outlined here.

Environmental Impact Studies

The Environmental Protection Agency requires a statement for every major federally funded project, discussing its effect on natural resources and on future land use. The HNTB Department of Environmental Quality and Conservation is entirely devoted to the preparation of environmental assessments and impact statements. Staff disciplines include geography; terrestrial and aquatic biology; environmental physics, engineering, sociology, and economics.

Regional, Basin and Facility Planning

Current regulations also state that nearly all construction projects receiving federal and state grants or loans must be part of a regional, basin, or facility plan adopted locally and approved by federal agencies. The HNTB

staff is experienced in the studies, analyses, mathematical modeling, and plans necessary to fulfill these requirements.

Wastewater Collection and Treatment

HNTB develops master plans for new installations or for orderly expansion of existing systems, performing infiltration-inflow investigations and cost-effective analyses to determine which is most economic and feasible - improvement of the collection system or the treatment plant. HNTB-designed plants now in operation range from primary to advanced treatment, with hydraulic capacities exceeding 50 MGD. The firm also prepares applications for demonstration projects, grant assistance, and discharge permits. Services during construction include equitable cost recovery studies, operating and maintenance manuals, and training of operators.

Storm Drainage

In new or recently developed areas, regulatory agencies usually require separate systems for sanitary sewers and storm drainage. In most established communities, however, the two are combined into one system, with convenient overflow points from which the heavily polluted initial storm runoff is conveyed directly to the receiving stream. Such communities are now being compelled to protect streams and to prevent periodic hy-

draulic overloading of wastewater treatment plants. HNTB not only has design experience, but performs cost/effectiveness studies to determine the most economical solution for a particular community — installation of a separate storm drainage system, treatment of runoff at the overflow points, or treatment facility modifications — to meet federal regulations.

Waterworks

HNTB waterworks analysis begins with identification of sources (surface, underground, or both) that will yield an adequate and treatable raw water supply for long-range domestic, institutional, and industrial needs. Advantageous locations for treatment facilities are indicated in the service district, and the most suitable process designated. Plans for supply, transmission, reinforcing, and distribution mains are then developed, and storage facilities are selected for their esthetically pleasing appearance. The objective is an acceptable, finished, quality product delivered to consumers under adequate pressure and at the most reasonable cost.

Dams and Reservoirs

Preliminary studies are conducted to determine if a community or region needs a reservoir for flood control, water supply, low flow augmentation, or recreation; if suitable sites are available,

and whether subsurface conditions will support a dam. The firm is also proficient in the complete design of such projects.

Solid Waste Disposal

HNTB prepares workable plans, based on current collection and disposal systems, population projections, available disposal sites, present and probable future volumes of solid waste, and analysis of various processing methods. The firm not only recommends the most feasible system and suggests means for financing construction and management, but prepares designs for transfer and weighing stations as well.

Control of Industrial Wastes, Air and Noise Pollution

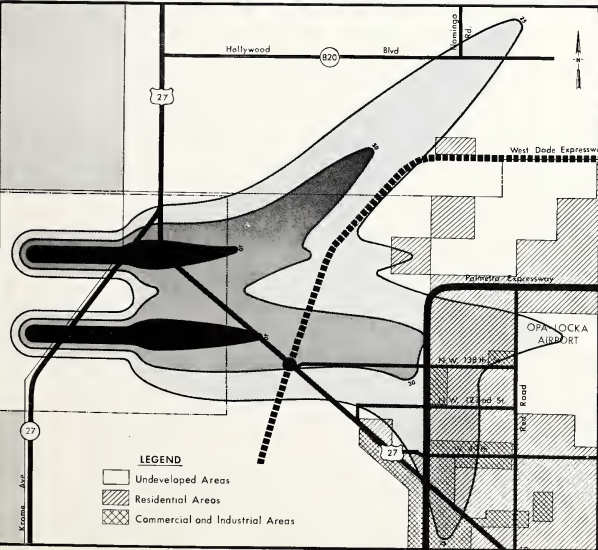
HNTB designs facilities for disposal of strong organic, high solids, heavy metal, oily, acidic, alkaline, and cyanide-bearing industrial wastes. Flows may be treated for direct discharge to the municipal system or to a receiving stream. For control of air pollution, the firm determines appropriate instrumentation and its location for sampling stack discharges, evaluates sample results, and establishes performance standards, so effective abatement systems can be installed. Noise impacts are forecast and noise intensity reduced to acceptable levels by special acoustical devices or careful design of emission stacks.

Cover

Aeration tanks at the Richmond, Indiana Sanitary District's wastewater treatment facilities

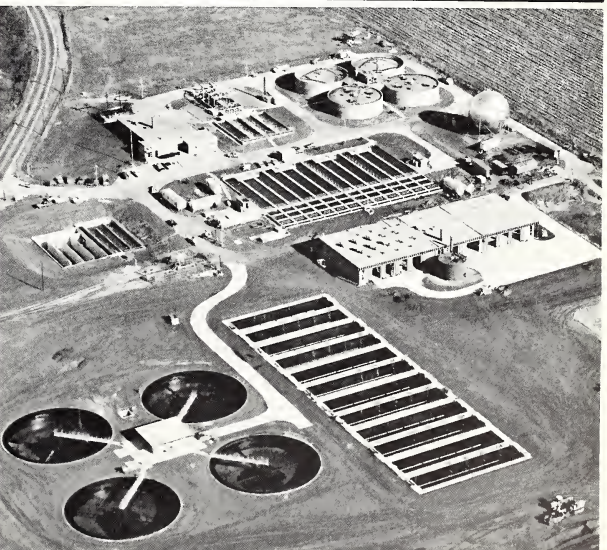
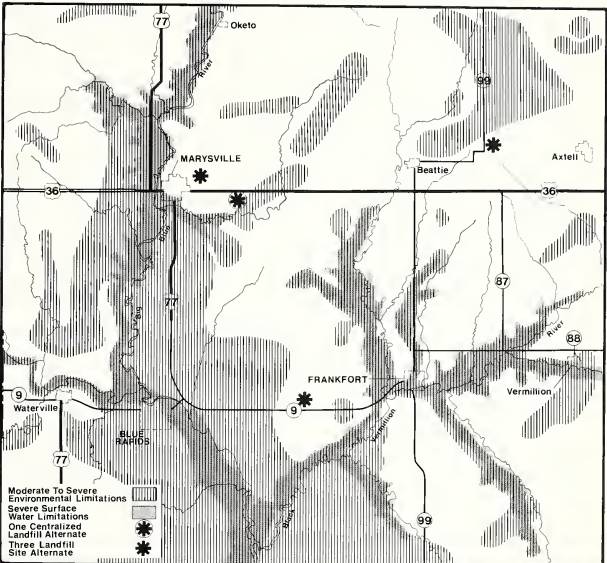
Atlanta, Georgia — Flint River diversion by means of 18' tunnel under Atlanta Airport as part of sanitary and drainage plan

South Florida Airport Study — Impact of aircraft noise on area surrounding proposed airport



Marshall County, Kansas — Possible locations for sanitary landfill

Terre Haute, Indiana — 24 MGD wastewater treatment plant



Selected Environmental Projects

Environmental Impact Studies

Heliport Study
Washington, D.C.

Airport Noise Forecast Study
Miami

Gov. A.E. Driscoll Expressway
South Central New Jersey

Recreational Community
Development, Wisconsin
Dells, Wisconsin

Water Resource Projects (14)
U.S. Army Corps of Engineers
Chicago

I-66 Transportation Alternates
Study, Fairfax-Arlington, Va.

Airport Site Selection Study
South Florida

I-205, Portland, Oregon

Regional, Basin and Facility Planning

Facility Plan, Three Rivers
Coordinating Council
Allen County, Indiana

Water Supply Evaluation
Norfolk Beach, West Virginia

Facility Plan, White River
Council of Local Governments
Delaware County, Indiana

Nashua Water Quality Plan
Southeastern New Hampshire

Facility Plan, Indiana Dunes
National Lakeshore
Porter County, Indiana

Water Quality Management
Planning, State of Indiana

Load Allocation Study
Fox River
State of Wisconsin

Wastewater Collection and Treatment

Staten Island Interceptor
New York City

Collection and Treatment
Anderson, Indiana

Collection
Manchester, New Hampshire

Treatment
Rhineland, Wisconsin

Wastewater Study
Regional Airport
Lisbon, Portugal

Sewer Master Plan
Collection and Treatment
Buffalo Creek, West Virginia

Collection and Treatment
Evansville, Indiana

Advanced Treatment
Fort Wayne, Indiana

Advanced Treatment
DeWitt Township
Clinton County, Michigan

Storm Drainage

Sewers
Manchester, New Hampshire

Expressway System Drainage
Kansas City

Sewers and Retention Basin
Wabash, Indiana

Crow Creek Flood Control
Study, Cheyenne, Wyoming

Sewers and Overflow Treat-
ment, Indianapolis

Retention Basin
Maplewood, Minnesota

Waterworks

Supply, Distribution and
Transmission Mains
Cape Coral, Florida

Water Supply
Alton, New Hampshire

Supply, Treatment, Distri-
bution and Storage
Speedway, Indiana

Supply and Treatment
Barefoot Bay, Florida

Cooling Water Supply and
Recycling, Division of General
Motors, Indianapolis

Water Supply Study
Rawlins, Wyoming

Water Master Plan
Treatment and Distribution
Buffalo Creek, West Virginia

Supply Study
Regional Airport
Lisbon, Portugal

Dams and Reservoirs

Terror Lake Dam
Kodiak Island, Alaska

Gordon Pittock Dam
Woodstock, Ontario

Lake Wildwood
Varna, Illinois

Lake Winnebago
Cass County, Missouri

Holiday Lakes
Oskaloosa, Kansas

Lehman Dam
Delhi, Ontario

Mill Creek, Cleveland

Solid Waste Disposal

Study, Design and Manage-
ment Plan, Jasper, Indiana

County-Wide Plan
Marshall County, Kansas

Study and Management Plan
Crawfordsville, Indiana

Study and Management Plan
Lawrenceburg, Indiana

Solid Waste Study
Regional Airport
Lisbon, Portugal

Control of Industrial Wastes, Air and Noise Pollution

PPG Industries, Fiberglass
Manufacture, Disposal of
Phenols, Shelbyville, Indiana

Container Corp. of America
Paper Manufacturing
Disposal of Whitewater
Wabash, Indiana

County Line Cheese Co.
Division of Beatrice Foods
Disposal of Milk Products
Wastes, Auburn, Indiana

Ford Motor Company
Steering Gear Plant
Disposal of Oils, Indianapolis

Indiana Steel & Wire Co.
Disposal of Acids and Cyanide
Muncie, Indiana

Philco-Ford Corporation
Refrigeration Products Divi-
sion, Disposal of Heavy
Metals, Connersville, Indiana

Chrysler Corporation
Electrical Parts Plant
Disposal of Metals and
Soluble Oils, Indianapolis

Everglades National Park
Regional Airport Site Selection
Aircraft Noise Study
South Florida

Alton Bay Pollution Abate-
ment Study, Control of Algae
Alton, New Hampshire

Statehouse Underground
Garage, Carbon Monoxide
Control System,
Columbus, Ohio

HNTB

Comprehensive Services

HOWARD NEEDLES TAMMEN & BERGENDOFF



Comprehensive Services

Current architectural and engineering design requires simultaneous application of a wide range of design specialties and a unified direction and organization. HNTB is one of the few consulting firms that can provide both.

Professional Staff

HNTB's staff of more than 1250 includes specialists in virtually all aspects of the planning-design-construction process. The firm has pioneered in the administration of multi-disciplined design teams, and its decentralized structure, with 29 domestic and five overseas offices, enables HNTB to offer the resources of a large national organization for solutions to local problems. On every project the local office is responsible for organizing and assembling the design team, drawing on skills from

other offices as the job requires, supervising the program, and providing direct, personalized client service at all stages.

Experience

Since its founding in 1914, HNTB has become one of the largest consulting firms in the world. In the last ten years, project construction costs have exceeded \$5 billion. Yet, every client receives top level attention as each project, large or small, is the responsibility of one of the firm's partners, and beyond him that of the entire partnership.

HNTB has successfully completed thousands of projects and has provided professional services in 49 states and a number of foreign countries for both public and private clients, including federal and state agencies, counties, cities, railroads, utilities, and private developers.

The firm has extensive experience in revenue bond projects, having conducted economic feasibility determinations for toll road, bridge, airport and other projects financed by \$3.2

billion in revenue bonds. On many of these, HNTB has continued to serve as general consultants for as long as 30 years, advising the owners on maintenance, operations, and improvements.

Expanding Services

In 1973, a merger with Henry B. Steeg & Associates, Inc., Indianapolis and Cape Coral, Florida, added a major environmental planning and engineering organization to HNTB's existing capabilities in environmental design.

A further broadening of mechanical, electrical, and chemical engineering capabilities came as a result of the 1974 acquisition of Frankfurter & Associates, Inc. Now a division of HNTB, the firm is well recognized for its services to the wood, pulp, and paper products industries.

The nationally known architectural and planning firm of Kivett and Myers joined HNTB in January 1975, expanding the range of architectural, engineering and planning services available. This new division has been responsible for a multitude of award winning architectural designs across the nation. A more recent and smaller acquisition is the Miami Planning firm of Paul Stutsman Associates, Inc.

Specialized Affiliates

Two affiliated firms provide important specialized services within the HNTB organization.

..Howard Needles Tammen & Bergendoff Inc. provides a general architectural practice, using HNTB planning and technical specialists for projects as required.

..Howard Needles Tammen & Bergendoff International Inc. offers comprehensive design services to clients outside the U.S.

Other folders are available on HNTB services and experience in particular fields.

Call or write: Information Services, HNTB, 1805 Grand Avenue, Kansas City, Missouri 64108 816-474-4900

Professional Services

Airport Planning and Design

Aviation Activity Forecasts
Regional Airport System Planning
State System Plans
Airport Master Plans
Noise and Air Analyses
Air Service Analyses
Revenue-Cost Analyses

Architectural Services

Commercial, Office and Industrial Buildings
Hospitals
Schools
Airport Terminals
Stadiums & Arenas
Structural Frames and Foundations
Recreational Facilities
Institutional Planning

Bridge Design

Long-Span Bridges
Movable Bridges
Short-Span Bridges
Utility Bridges
Inspection and Renovation

Urban and Regional Planning

Comprehensive Planning
Functional Plans, Special Studies, Project Plans
Transportation Planning
Socio-Economic Studies
Resources Planning
Urban Design
Parks
Environmental Assessment and Impact Studies

Construction Management

Inspection of Materials and Workmanship

Coordination of Contractors' Operations
Certification for Payments
Progress Reports
Value Engineering

Environmental Engineering

Wastewater Collection and Treatment
Waterworks
Regional and River Basin Plans
Storm Drainage and Stream Channel Improvements
Industrial Waste Disposal
Plant Operator Training
Solid Waste Disposal
Noise and Air Pollution Control
Dams and Reservoirs

Environmental Quality and Conservation

Impact Statements
Environmental Studies
Resource Evaluation

Geology and Foundations

Supervision of Borings
Analysis of Soil Tests
Photo-Geologic Interpretation
Foundation Recommendations

Highway Designs

Urban and Rural Freeways
Primary Highways
Interchanges

Industrial Parks and Shopping Centers

Site Location and Marketability Studies
Site Development

Landscape Architecture

Landscape Design
Site Planning
Master Planning — Housing, Colleges, Parks
Highway Esthetics

Management Services

Consultation on Engineering Organization
Operation and Maintenance of Revenue Bond Projects
Planning and Urban Renewal Administration
Systems Engineering — CPM and PERT
Materials Handling

Marina and Port Facilities

Need and Feasibility Studies
Hydraulic and Subsurface Analyses
Comprehensive Plans
Design Plans and Specifications
Continuing Engineering Management

Transit Planning and Design

Studies and Investigations
Roadbed and Support Structures
Station Design

Mechanical-Electrical-Chemical Systems

Movable Bridge Machinery
Heating, Ventilating and Air Conditioning
Plumbing and Process Piping
Lighting
Machinery and Equipment Installation
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703 548-6126

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Atlanta, Georgia 30303
404 523-1651

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P.O. Box 8658, Baltimore-
Washington International
Airport, Maryland 21240
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Baton Rouge

5615 Corporate Boulevard
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Suite 3050-Prudential Center,
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617 267-6710

Buffalo

16th Floor-Statler Hilton Hotel
Buffalo, New York 14202
716 852-0688

Cape Coral

1402 Cape Coral Parkway
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813 542-1143

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Building, Casper, Wyoming
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25301, 304 343-8841

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Chicago, Illinois 60601,
312 332-5035

Cleveland

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Cleveland, Ohio 44114,
216 522-1140

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Dallas, Texas 75240,
214 661-5626

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Denver, Colorado 80218
303 322-9442

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201 227-6460

Indianapolis

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317 257-3105

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Kansas City, Missouri 64108
816 474-4900

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John L. Cotton
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Miami, Florida 33159
305 871-6350

Milwaukee

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Milwaukee, Wisconsin 53216
414 463-2310

Minneapolis

6750 France Avenue, South
Minneapolis, Minnesota
55435, 612 920-4666

Newark

P.O. Box 207
Newark, Delaware 19711
302 737-0941

New York

1345 Avenue of the Americas
New York, New York 10019
212 757-4060

Orlando

P.O. Box 5667
Orlando, Florida 32805
305 849-6310

Overland Park

7500 West 95th Street,
Overland Park, Kansas 66212
913 642-9666

Philadelphia

551 West Lancaster Avenue
Haverford, Pennsylvania 19041
215 525-7170

Other Officers of HNTB Corporations

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Eugene P. Rausa
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Richmond, Virginia 23219
804 648-4404

Seattle

201 Elliott Avenue West
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206 285-5133

Washington, DC

130 North Royal Street
P.O. Box 186
Alexandria, Virginia 22313
703 549-9100

Woodbridge

P.O. Box 671
Woodbridge, New Jersey 07095
201 636-0600

Beirut

Blue Building, Abdel Aziz St.
P.O. Box 11-4041, Beirut,
Lebanon Phone 354-763

Lisbon

Rua Joaquim Antonio de
Aguir, 27-1 ☉ E, Lisbon 1,
Portugal Phone 536596

Saigon

USAID Highway Advisor,
Congen/4, Can Tho, APO
San Francisco, Calif. 96243

Rio de Janeiro

Caixa Postal 1231-ZC-00
Rio de Janeiro, Brazil S.A.
Phone 260-2012

Divisions of HNTB

HNTB Inc.

HNTB International Inc.

Frankfurter Inc.

201 Elliott Avenue West
Seattle, Washington 98119
206 285-4411

Kivett and Myers

TenMain Center, Suite 950
Kansas City, Missouri 64105
816 842-8100

Stutsman Associates

8675 N.W. 53rd Street, Suite 112,
Miami, Florida 33166
305 592-0820

HOWARD NEEDLES TAMMEN & BERGENDOFF



Support Services

HNTB support services most frequently employed in serving clients are briefly presented in this folder.

Electrical Engineering

Engineering studies, designs, plans, drawings, and technical specifications are provided for any electrical work required by an HNTB project. The great variety of electrical design can be indicated by a few examples: utility relocations; systems for remote control by interconnect multiplexing, closed circuit TV, or radar surveillance; matrix signs for traffic control; microwave relay systems; airport approach systems; toll collection and accounting facilities; electronic noise and vibration absorbers; highway lighting; movable bridge controls; cathodic rust protection for underground steel; hospital security, paging, and nurses' call systems; and lighting for buildings.

Mechanical Engineering

In addition to facilities for heating, ventilating, air conditioning, and humidity and temperature control for buildings, HNTB services include mechanical design of movable bridge machinery and other specialized mechanical-electrical systems. Maintenance and operating manuals as well as operational training are also provided.

Computer Services

From the inception of electronic computer and data processing equipment, HNTB recognized its potential for rapid and accurate solution of the many complex and time-consuming problems associated with present-day construction projects. As a result, the firm has an extensive library of civil engineering computer programs, including many to provide graphical plots or line drawings. Computer centers are located in the Kansas City and New York offices, and terminals in other offices to a major outside EDP installation provide almost unlimited capacity.

HNTB engineering personnel, trained in IBM and General Electric electronic data processing schools, are able to collect, catalog, and analyze the socioeconomic, technological, and financial data necessary to effectively serve clients' interests. Standard tools are linear and dynamic programming, queuing and inventory theory, and simulation and management planning models. Other techniques include econometrics, benefit-cost analyses, and human engineering or mathematical psychology.

Surveys and Mapping

Through maintenance of fully equipped field crews, HNTB can provide control surveys to any required order for mapping, design, and construction purposes. Complete services are also available for planning and execution of mapping programs.

Soil Mechanics and Foundation Engineering

Reconnaissance and site evaluations are made of basic geologic conditions, surface soil drainage, and ground water, as well as material sources. Sub-surface explorations and laboratory testing programs are developed and executed to support stability analyses, embankment and building settlement predictions, bearing capacity analyses, ground water and seepage analyses, pavement design and evaluations, and earth and rockfill dam design.

Foundation engineering services include studies and recommendations for types and sizes of piling, caisson design, soil and rock bearing footings, foundation settlement analysis, sheathing and cofferdam design, and excavation methods. Instrumentation systems for detecting, measuring, and recording movement in the earth or in structures are designed and evaluated.

Soil test conducted to determine subsurface characteristics

Computer services

Mobile information center for Milwaukee's Stadium Freeway project

Effective construction supervision requires continuous surveillance, review, coordination, and communication



Support Services (Cont)

Community Participation

A consultant's recommended solution to a highway, transit, airport, or planning problem is no longer "just accepted" by society. Local residents, concerned about such issues as cost, ecology, and the environment, wish to participate in the decision making. The role of the professional today is to gain a clearcut picture of specific problems and viable alternatives, pointing out the advantages of each to every identifiable segment of the community. Various communication concepts are possible:

- Community attitude surveys
- Workshops and group meetings
- Explanatory slide shows, films, brochures, or circulars
- Releases for newspapers, radio, TV

In small informal meetings, HNTB teams carry on a face-to-face dialogue with individuals providing local citizens with the opportunity to express their concerns, goals, and objectives. This permits the team to better develop and evaluate alternative solutions which may result in a more acceptable conclusion. The ultimate public hearing may then become a mere ratification of the solution, one the community has already agreed is equitable, feasible, and desirable.

Construction Inspection

The principal objective of construction inspection is to insure the quality of the resulting project. HNTB inspection teams practice a multitude of disciplines for control of three goals: cost, quality, time and progress — all interrelated.

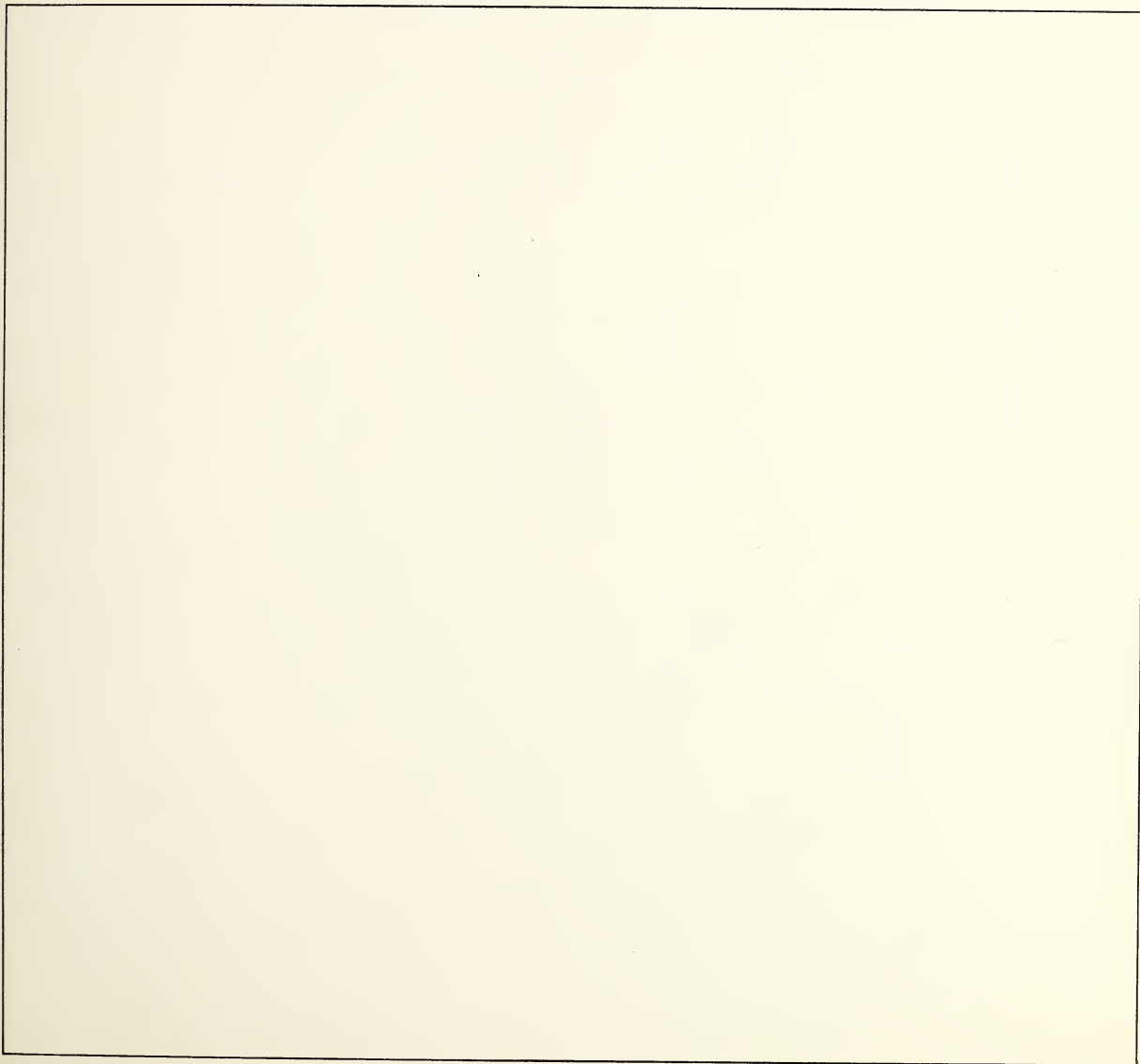
Typical services include:

- on-site inspection for conformance with plans and specifications
- review of testing laboratory reports
- checking construction surveys
- preparation of pay certificates, change orders, progress reports
- coordinating utility adjustments and relocations
- conducting conferences and job meetings
- review of contractors' claims

Other folders are available on HNTB services and experience in particular fields.

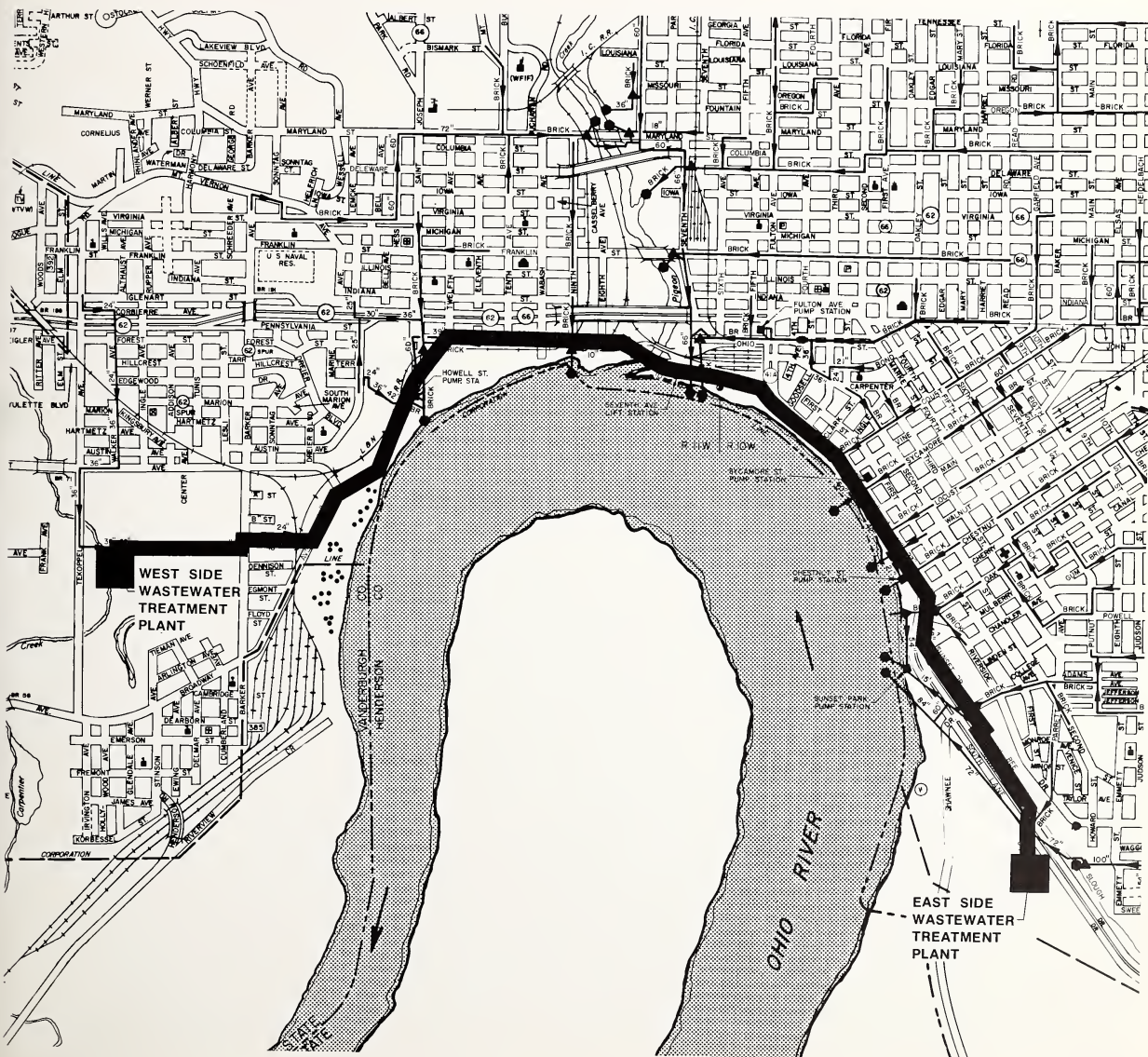
**Call or write: Information Services,
HNTB, 1805 Grand Avenue, Kansas
City, Missouri 64108 816 474-4900**

HOWARD NEEDLES TAMMEN & BERGENDOFF



Client: City of Evansville Board of Public Works

HNTB Services:
Design secondary treatment additions
Estimate operating, maintenance, and total project costs
Assist in government grant applications
Investigate sewer system overflow

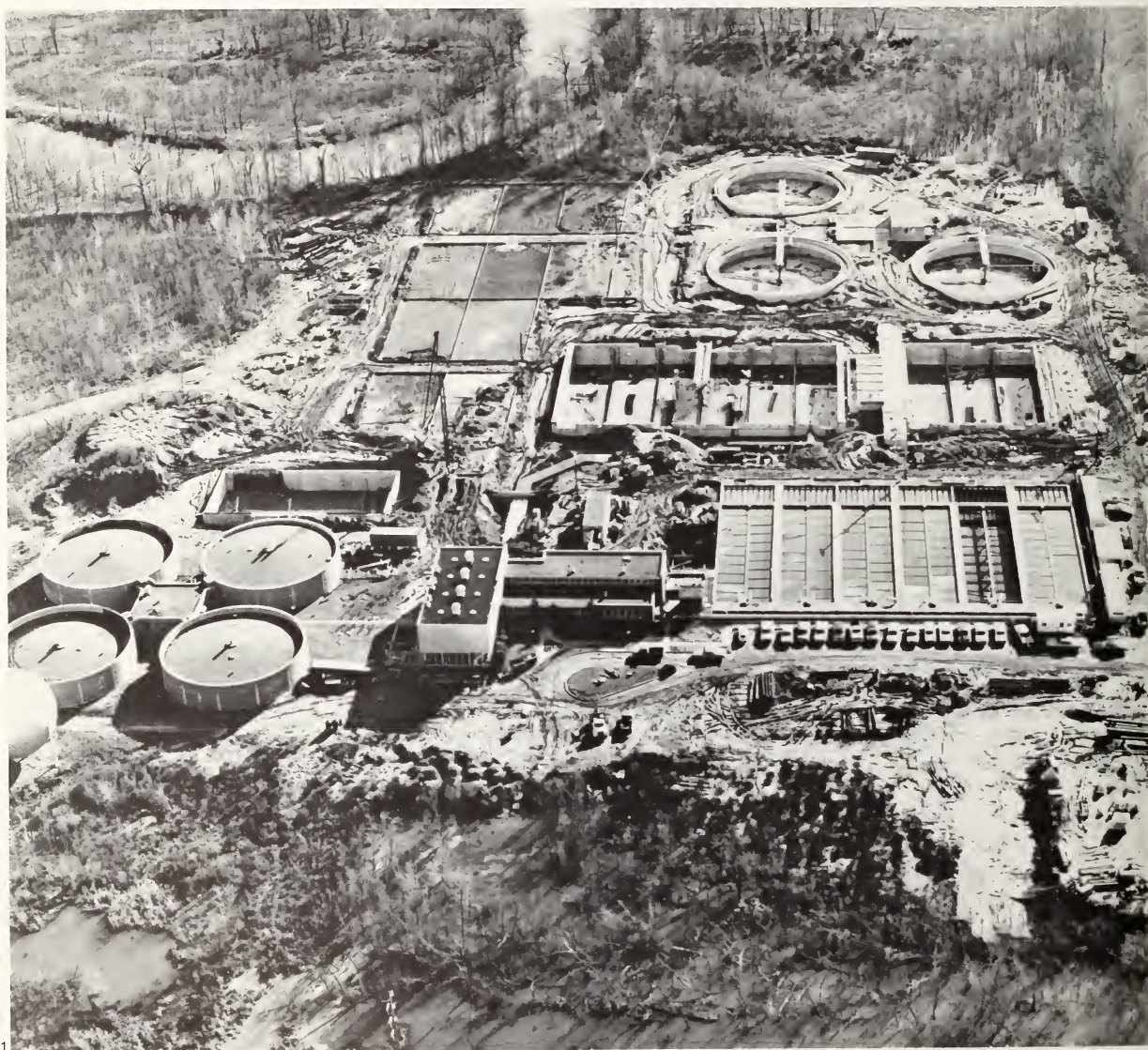


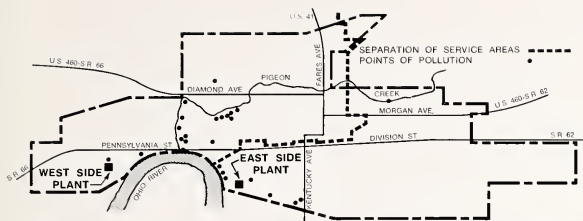
The necessity for adding secondary treatment facilities to not one, but two, wastewater primary treatment plants in Evansville, Indiana, led to discovery of several sewer problems and eventually resulted in HNTB's Steeg Division preparing a master plan for storm and sanitary sewers in the city and much of the surrounding Vanderburgh County.

Natural topography initially dictated construction of the two separate plants, as a ridge divides the city into two drainage basins. When calculations of theoretical flow based on current population and land use were found to be 5 MGD more than actual flow at the west plant,

investigators went looking for reasons and found 45 points of overflow along Pigeon Creek, Bee Slough, and the Ohio River. One large industry, which was inadvertently bypassing the treatment plants, immediately remedied the situation and no longer discharges most of its waste directly into the receiving waters. Seventeen other sources of polluting material were eliminated, and the remaining 27 were to be monitored for about a year to determine the magnitude, duration, and direction of inflow or overflow.

Capacity to be provided in the new secondary additions was determined not only from existing rated capacity and average daily flow





over a year's time, but from census figures for the city, the metropolitan area, and the county, as well as from future land use studies. The HNTB staff worked closely with the Evansville planning department on realistic projections of population and probable location and extent of land development.

Additions at each plant included aeration tanks, air supply, sludge pumping facilities, secondary settling tanks, chlorine contact tanks, and improvements to the sludge digestion facilities, in a modular design so capacity could easily be increased as needed. The city decided on three 6 MGD (million gallons per day) modules at the



east plant for an 18 MGD capacity, 5.8 MGD more than average flow. Three 6.9 MGD modules at the west plant resulted in 20.6 MGD total capacity and a 13.8 MGD excess, as growth is expected to be more rapid in that part of the city.

Annual operating and maintenance costs were estimated so the city could budget accordingly. A sizable economy was effected by installation at the east plant of vacuum filter equipment with the capacity to dewater digested sludge produced at both plants. The west plant sludge is pumped through a 21,500-foot pipeline to the east side station for further processing.

Cover: Four-mile pipeline to convey digested sludge from west side plant to east side plant for dewatering.

1. West side plant.
2. East side plant.
3. Insulated heated 8-inch force main conveying treated sludge across Pigeon Creek (portion of pipeline).
4. Tunnel gallery providing all-weather access between buildings and housing pipes for return sludge, waste sludge, primary effluent, and potable water.
5. Influent piping for contact stabilization process and vertical pipes for return sludge.
6. Pressure pipe conveying primary effluent to three 3-pass aeration tanks.

Because of HNTB's knowledge of current regulations, eligibility, and government forms, the firm was also asked to assist with fund applications. The City of Evansville was awarded a federal grant of \$5,236,000 under provisions of the Federal Water Pollution Control Act and \$2,380,000 by the State of Indiana, leaving \$4,135,000 to be raised by revenue bonds, for a total project cost estimated at \$11,300,000.



Wastewater Treatment Plant Additions Speedway, Indiana

Client: Town of Speedway

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HNTB Services:

- Evaluate existing wastewater treatment facilities
- Recommend and design additions
- Estimate total project and annual operating costs
- Represent owner during construction

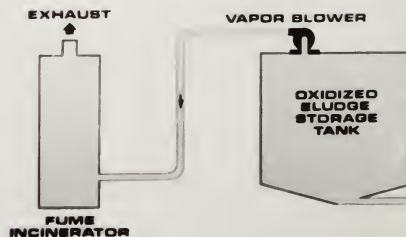
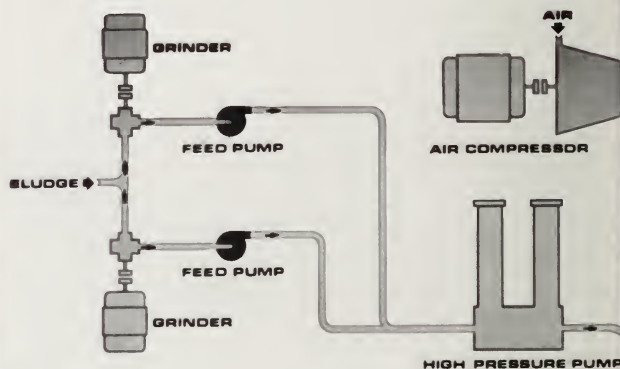
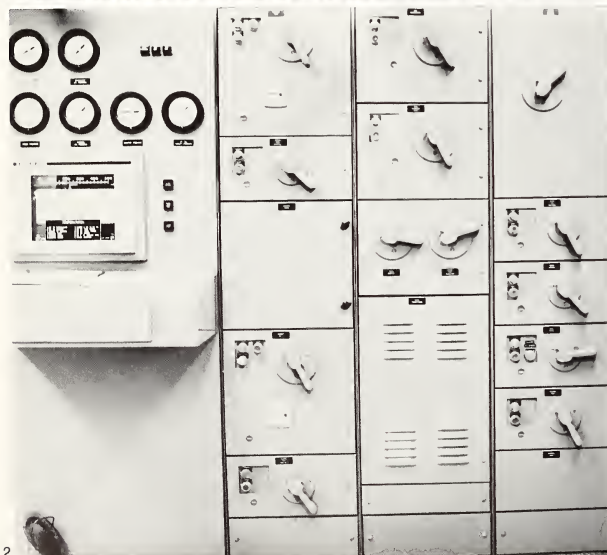


Surrounded by the western environs of Indianapolis, the Town of Speedway is not only the scene of the annual Memorial Day 500-mile race, but a community which experienced a 54.6% increase in population in 10 years. The board of trustees of the civil town, recognizing that capacity of the existing wastewater facilities would be inadequate for continued rapid growth, authorized HNTB's Indianapolis office to develop cost-effective alternatives to best satisfy Speedway's singular requirements.

Rapid construction of many multi-family dwelling complexes like the

Westlake Apartments on West 10th Street and International Village in the northwest part of town was the main reason for the sudden rise in populace. The number of expanding prominent industries also located there was another factor. Coca Cola, American Clay, Esterline Angus, Detroit Diesel-Allison Div. of G.M., and Linde Division of Union Carbide are representative of the industrial mix.

The existing trickling filter plant had a rated capacity of 4.0 MGD (million gallons per day). Plant records showed the volume of flow being treated, but the amount of untreated wastewater which might

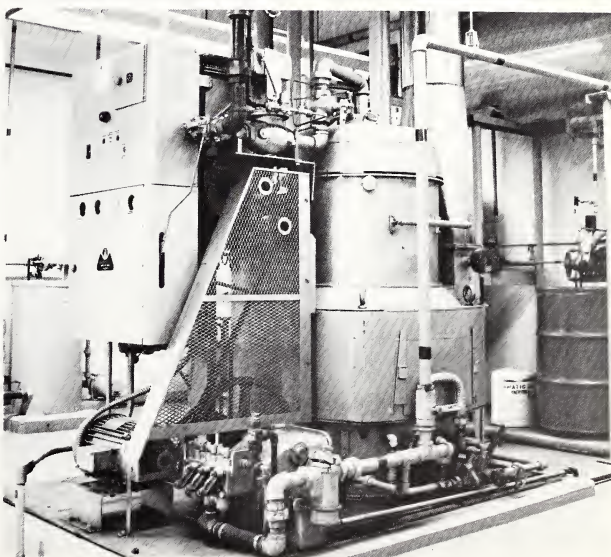
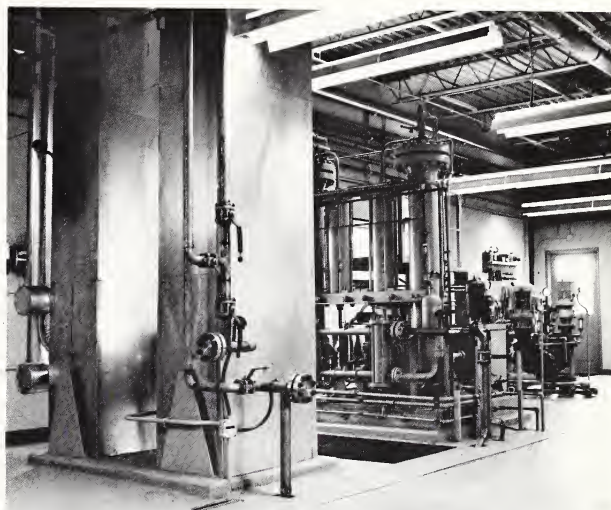
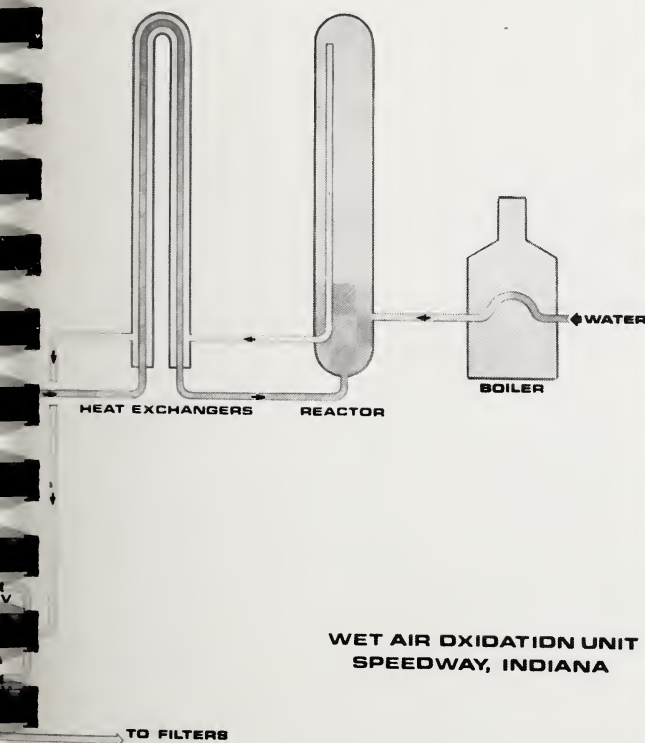


be bypassing in the sewer system and at the plant was unknown. HNTB engineers and technicians initially made flow measurements at selected points and identified major problems. Treated flow averaged 3.73 MGD, but 0.77 MGD were routinely bypassing the plant and discharging directly into the receiving waters. Pollution was far worse during wet weather when 2.8 MGD bypassing the plant were measured. Sewer system overflows were also evaluated.

Consideration of flow measurements, industrial questionnaire results, population projections, and public input indicated that facility

improvements and additions with a rated capacity of at least 7.5 MGD were needed. Quality of plant effluent also required upgrading to meet current stream standards.

Conversion of the original plant, built in 1954, to a 7.5 MGD advanced wastewater treatment facility proved to be far more economical than construction of an entirely new plant to provide the additional capacity so patently needed by Speedway's burgeoning population. Thus, HNTB proposed the trickling filters be replaced with new direct oxygenation units utilizing high purity gaseous oxygen.



Other improvements consisted of better communiton and grit removal facilities, conversion of secondary settling tanks to primary ones, new secondary tanks, chlorination tanks, a new wet-air oxidation sludge conditioning system, and a new sludge vacuum filtration unit. Control gates were installed at the existing interceptor sewer and at secondary bypass structures, and a garage was built for maintenance and storage of plant vehicles and equipment. HNTB also prepared an operating and maintenance manual and provided training for treatment plant personnel.

Total project cost was \$3,809,000, a large portion of which was covered by a federal grant under terms of the Federal Water Pollution Control Act.

Cover: Control unit and three pressure swing absorption units for generating oxygen.

1. Storage tank for oxidized conditioned sludge prior to disposal as sanitary landfill.
2. Control panel for wet air oxidation sludge conditioning system.
3. Flow panel for system.
4. Heat exchanger to return heat from reactor for preheating of sludge from high pressure pumps.
5. Boiler providing steam to reactor.
6. Covered oxygenation tanks and mechanical mixers to blend contained oxygen — rich atmosphere with activated sludge.
7. Aerial view of entire plant.



6



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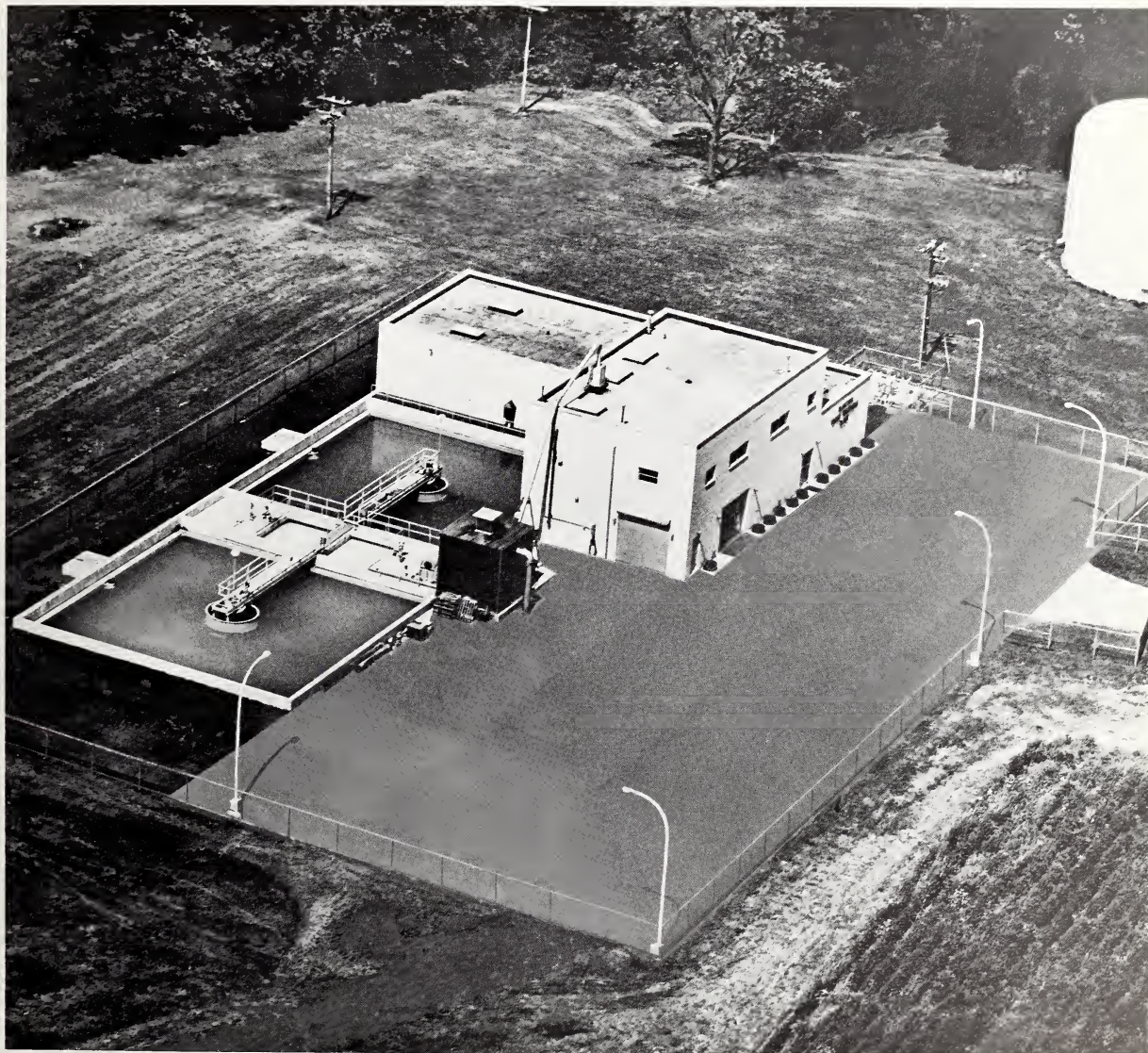
Waterworks

Bluffton, Indiana

Client: City of Bluffton

HNTB Services:

Evaluate existing water supply and system
Recommend and design improvements
Estimate total project and operating costs
Prepare summary report and present testimony to Public Service Commission



Cover: 3.0 MGD plant treating both ground and surface water supplies.

1. 25-ton lime storage bin and slaker.
2. Operating console and sand filters.

Bluffton, experiencing a marked increase in water demand, accompanied by a chronic falling off of pumping capacity at its well field, called upon HNTB's Steeg Division to evaluate the city waterworks and recommend solutions to prevent problems. All pumping facilities were in use 24 hours per day, so the water supply obviously had to be augmented. Further, the community was frequently plagued by red water, caused by the presence of iron.

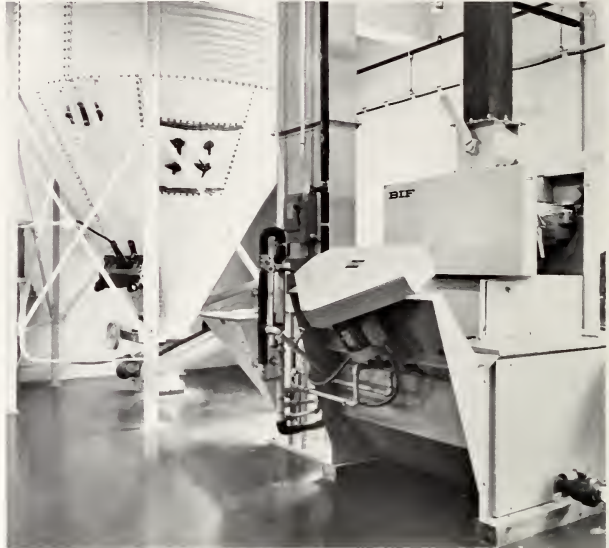
The four ground water wells in the southwest part of the city supplied one million gallons per day (1.0 MGD), peak capacity which could be expected from that field; thus, additional wells there were not the answer to the supply situation. Three new wells, drilled on a site purchased in the northeast part of the city, produced enough additional water to meet existing normal demands, but the seven wells were not adequate for peak requirements and future use.

The Wabash River appeared to be a logical supplementary source of supply. Two horizontal screens were laid on the river bottom to strain out fish, leaves, and debris, and two low-lift pumps, on elevated platforms to keep them above flood level, propelled water to the new treatment plant. Provisions were needed for hydraulic backwash of the screens if they become clogged.

Design of the 3.0 MGD treatment plant includes an aerator to blow out entrained gases and oxidize the iron in the water. From there, the water enters a rapid mix basin, then a slow mix or flocculation basin, and then a clarifier basin where the floc settles out, removing much of the iron. Four rapid sand filters take out the remaining iron, and the resulting clear water, to which chlorine is added for a residual of one part per million, is pumped either into the distribution system or a new elevated storage tank.

During peak periods, river water is mixed with the well water. Liquid alum and dry lime and soda ash are added in the rapid mix basin, so that silt, clay, and sand will be removed when floc masses settle in the clarifier basin. Chlorine is also introduced to kill any algae and bacteria in the river water. An on-site ground reservoir stores water for backwashing the filters. The distribution system was extended to newly annexed parts of Bluffton, and several dead-end mains were looped for better circulation, increased capacity, and greater fire protection.

Total project cost was estimated at \$1,730,000 and revenue bonds issued in that amount. Various tests at the treatment plant, some daily, others hourly, assure the city a safe, completely potable water. In addition, the facilities were designed to provide maximum daily pumpage for a predicted population of 10,000 in the year 1990, supplying all Bluffton consumers with sufficient water of a desirable quality at an adequate pressure.



Waterworks

Connersville, Indiana

Client: City of Connersville

HNTB Services:

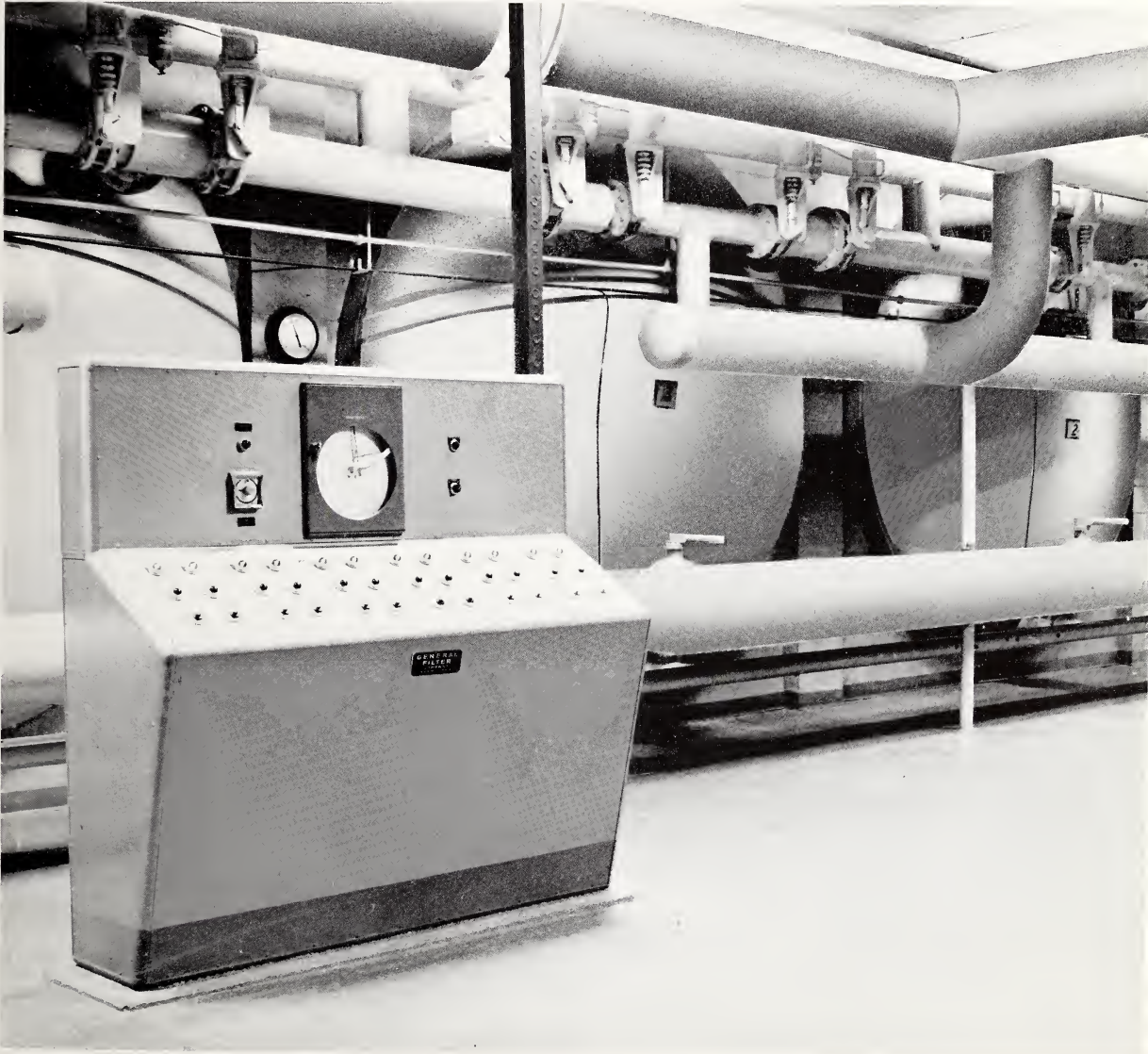
Determine needed additions and improvements

Prepare final design plans and specifications

Estimate total project cost and revenue bond requirements

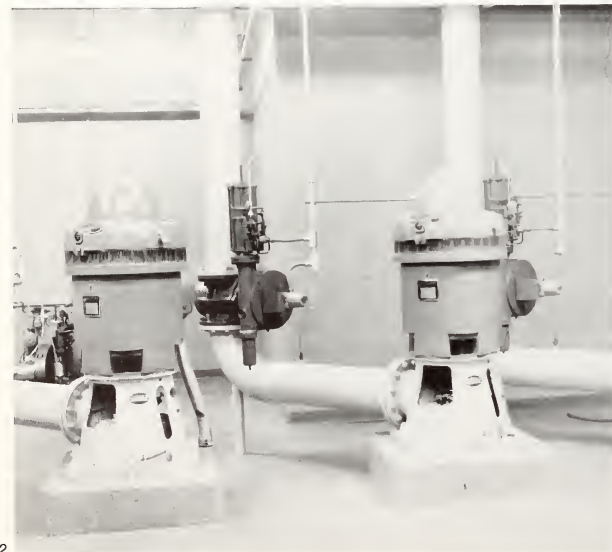
Recommend annual amounts for operation and depreciation accounts

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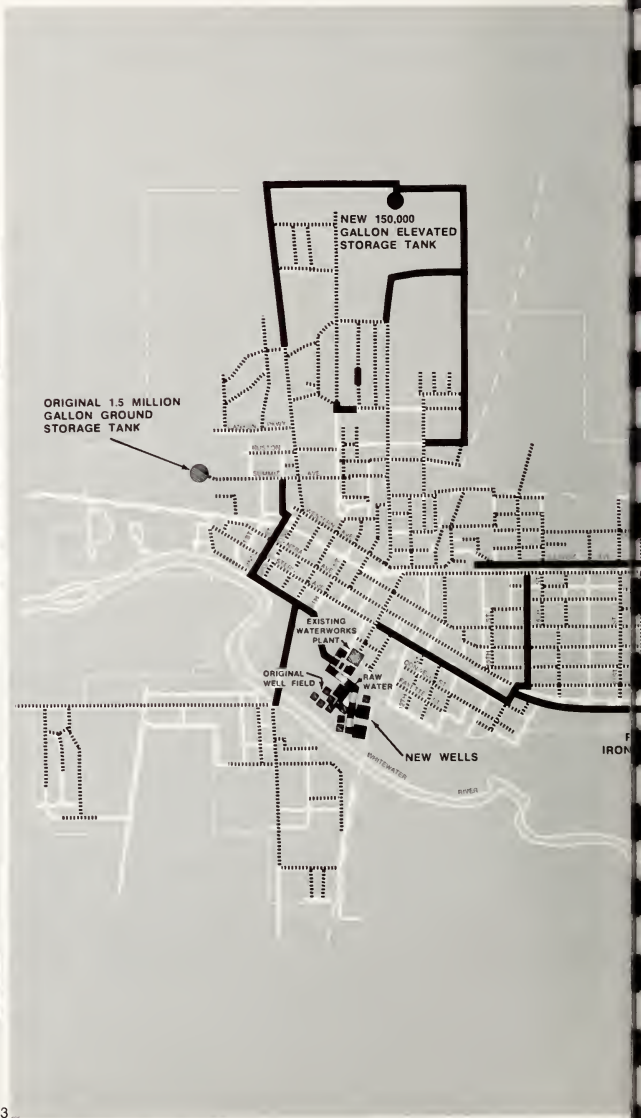
Connersville had a long history of consumer complaints about red rusty water, low pressure in the central and north sections of the city, and inadequate fire protection in West Connersville. HNTB's Steeg Division found that the city was blessed with an aquifer which would satisfy water needs for many years to come so the problem was not one of supply but of bringing that water to the surface, removing the iron, and providing adequate mains and storage facilities.

The main well field at 9th and Fayette contained 15 active wells



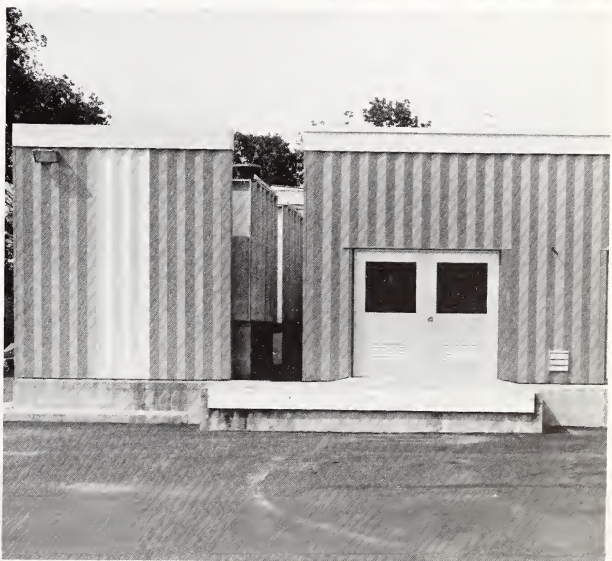
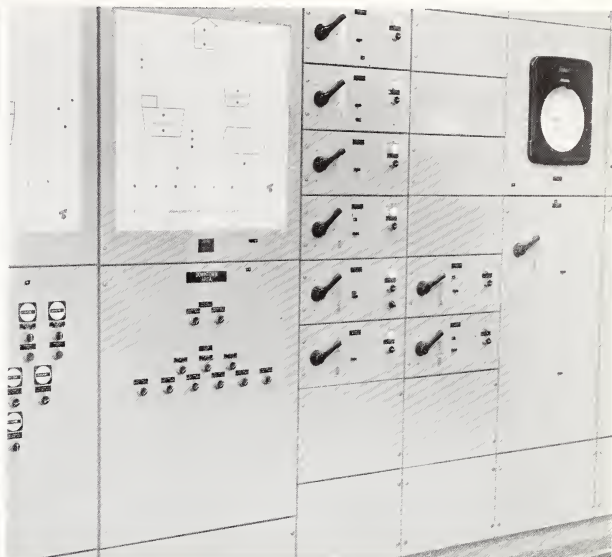
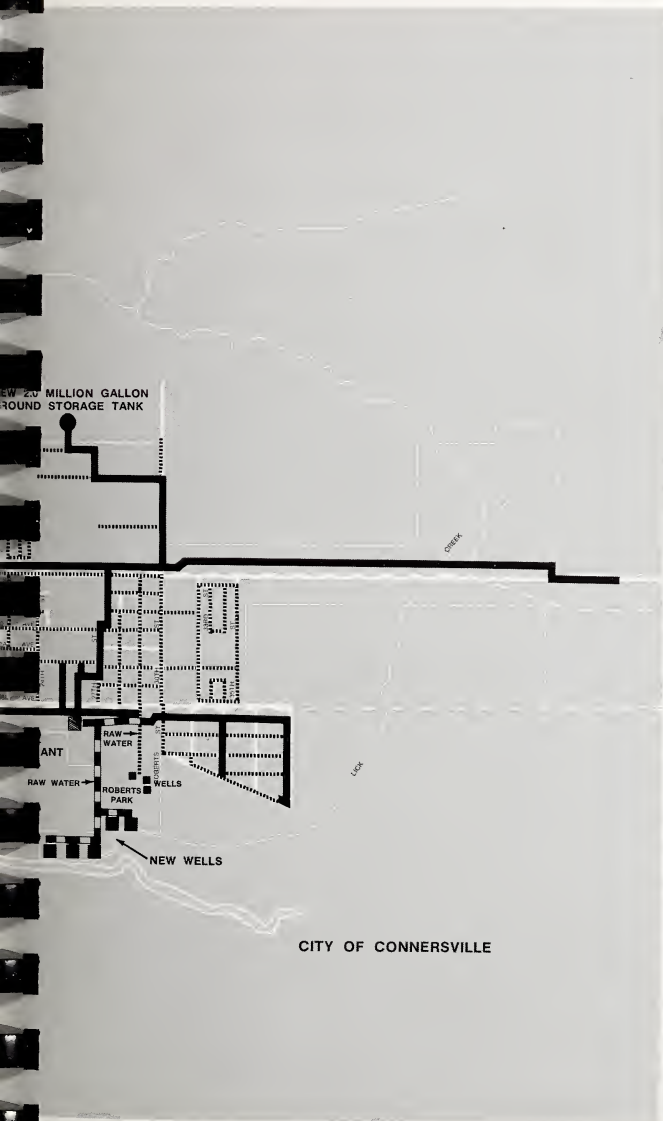
which pumped to two on-site reservoirs, and the only treatment given the water was chlorination. A third reservoir was located at Jenny's Point, a high hill at the south end of town. Three other wells in Roberts Park pumped directly to the distribution system without treatment of any kind. Five new wells were proposed there and three at the main field, all eight to be 60-inch diameter gravel-walled, with a 1200 gpm pump for each. All original wells were plugged and retired.

Two iron removal treatment plants were designed, one an 8.0 MGD



rated capacity to be housed in a new building at Roberts Park, and one a 4.5 MGD rated capacity to be installed in a former electric power plant at 9th and Fayette, thus holding down total project cost. At both, raw water is pumped from the wells to fiber glass aerators which reduce carbon dioxide and oxidize iron and manganese. The water is then pumped through six horizontal pressure filters (to remove the iron and manganese), chlorinated, metered, and sent to the distribution system. New electrical installations provide remote automatic control of all wells and treatment facilities.

By adding nearly 15 miles of larger feeder mains, ranging from 6 to 20-inch ductile iron or cast iron cement-lined pipe, an adequate water supply could be transmitted not only to all parts of the city, but to industrial customers, like Philco-Ford which requires large volumes of water. The three existing reservoirs were supplemented by a 2.0 MG above ground steel storage tank on Elephant Hill in the northwest section of Connersville. A 150,000-gallon elevated storage tank provides fire protection and uniform pressure for the numerous customers in West Connersville.



Total project cost and necessary bonds were estimated at \$1,900,000. Total waterworks depreciable property old and new now has a value of \$3,118,000. Applying 1½% as a reasonable depreciation allowance, HNTB recommended that at least \$46,800 be set aside annually in the depreciation account.

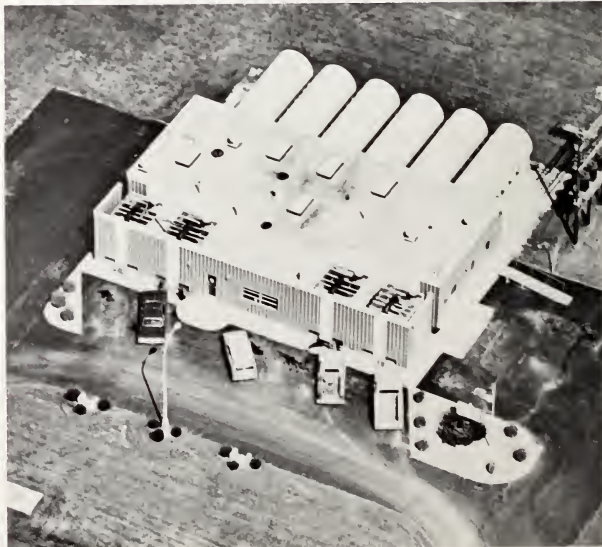
The facilities raised rated capacity of the Connersville waterworks from 6.5 to 12.5 MGD and solved the problems of low pressure, undesirable "red water", and lack of fire protection.

Cover: Horizontal pressure filters with operating console in foreground.

1. Outside portion of six horizontal pressure filters.
2. Short-coupled turbine pumps (six in all at 2 MGD each) for pumping aerated water through pressure filters to distribution system.
3. Original and new water facilities in relation to community.
4. Controls for well fields; pump and aerator starters; elevated tank level gauge.
5. Fiber glass induced-draft aerators screened by wall panels at left; loading dock for one-ton chlorine containers in center.
6. Roberts Park water treatment plant.
7. Aerial of Roberts Park plant showing top of aerators in front and horizontal pressure filters in rear.



6



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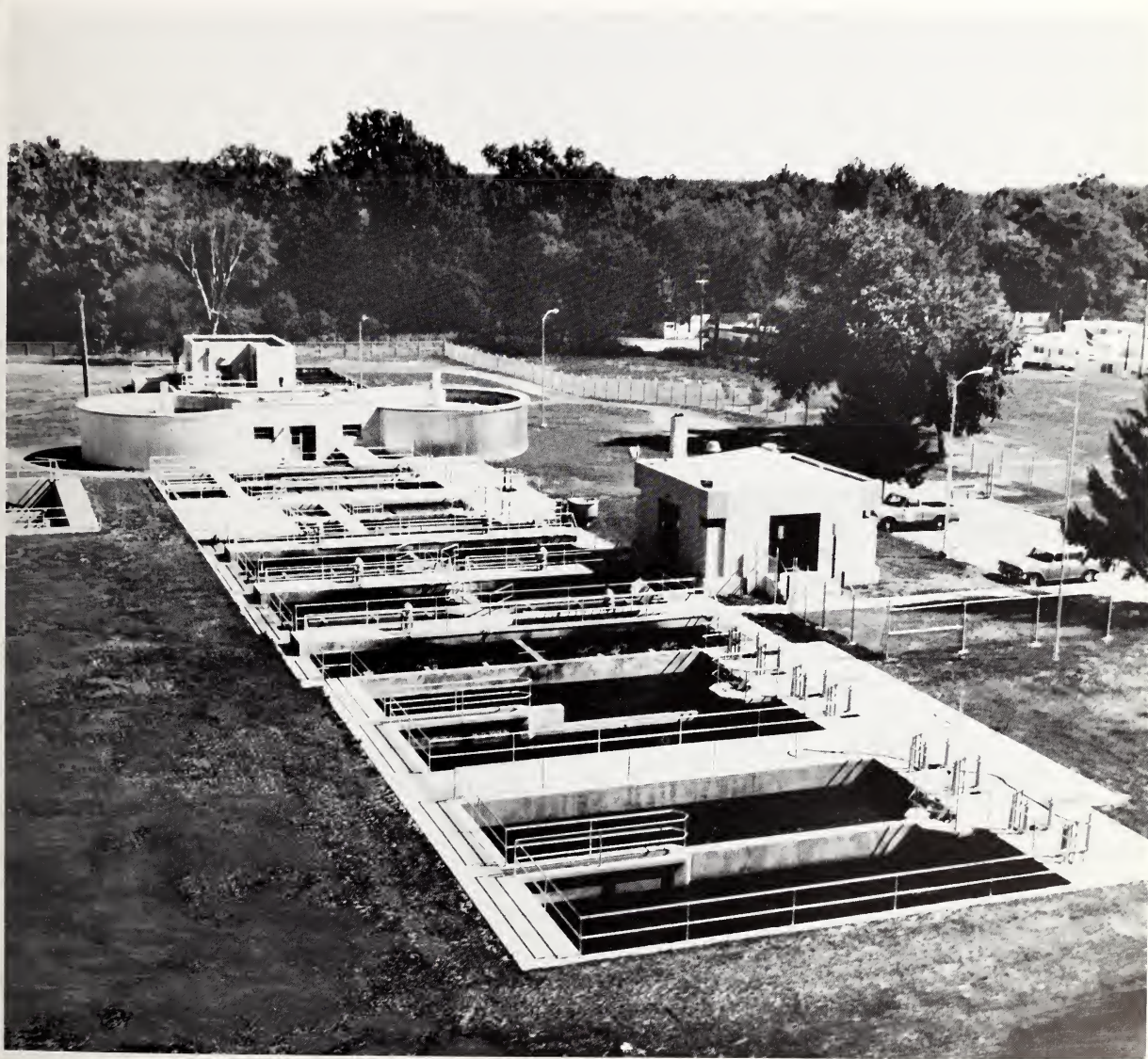
Wastewater Disposal Facilities

Auburn, Indiana

Client: City of Auburn

HNTB Services:

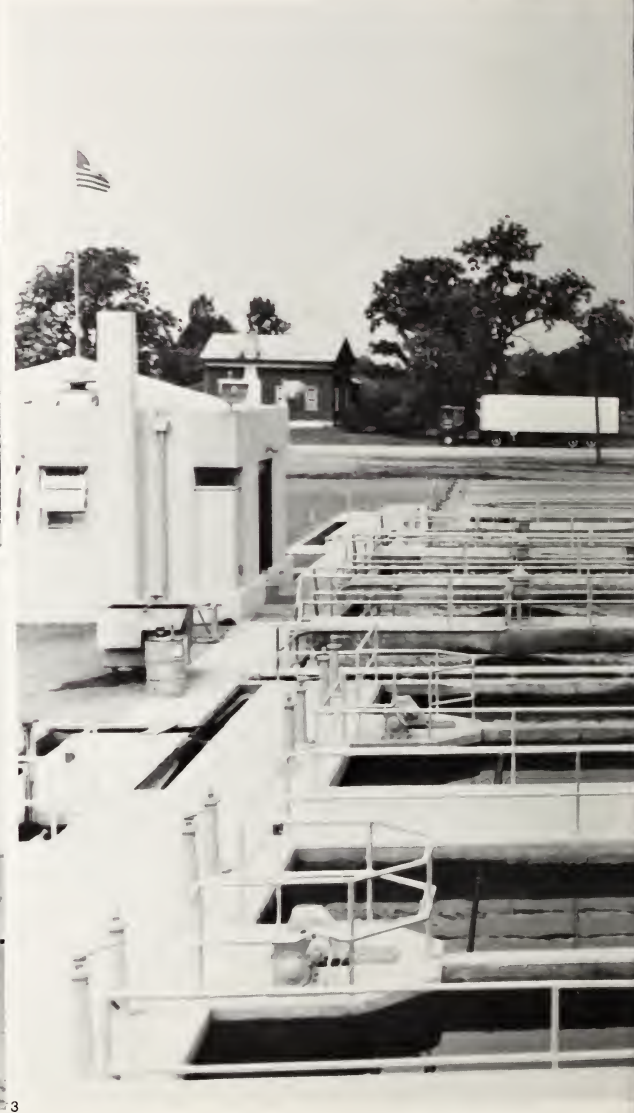
- Make engineering study of existing facilities and needs
- Recommend and design improvements and additions
- Estimate total project cost and annual operating expense
- Prepare report for revenue bond prospectus



Auburn, a city of 6900, had an extensive pollution problem, so the common council authorized an engineering study of their entire wastewater disposal system by HNTB's Indianapolis office. The firm ascertained that Cedar Creek was being contaminated by combined sewer overflow at 22 points, and by adjacent subdivision sewers outside the city limits, discharging directly into the creek at two additional points. A closed circuit television inspection was undertaken to evaluate selected interceptor sewers within the system. Portions were found to be salvageable by this study method, and

repairs were determined to be both feasible and economical; thus, unnecessary replacement was avoided.

However, some trunk sewers were found to be badly clogged, severely deteriorated, or inadequate in size for the loadings to be conveyed. Not only was ground water infiltration excessive due to condition of some of the sewer lines, but major outfalls were unprotected and the creek often backed up into the system during heavy storms. More than 3.0 MGD of combined wastewater was estimated to be



entering the sewerage system. Capacity of the conventional activated sludge treatment plant was 0.75 MGD (million gallons per day), but more than 1.0 MGD of wastewater was being received for treatment. The treatment plant had no grit removal or chlorination equipment, the pumps and motors had already exceeded their normal working life, major plant components were operationally inadequate, exposed concrete was badly deteriorated, and laboratory facilities were lacking.

With these facts in hand, HNTB design engineers went to work. Sewers and outfall structures were repaired to reduce infiltration and inflow, industrial wastewater was separated, and new sewers were provided for unsewered areas and to improve service for existing customers. Considering the effect of sewer improvements and using records of average daily potable water pumpage, a design wastewater flow of 2 MGD was selected for the treatment plant, a capacity which may easily be doubled when need dictates.

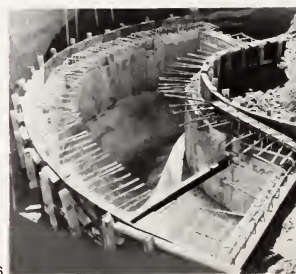
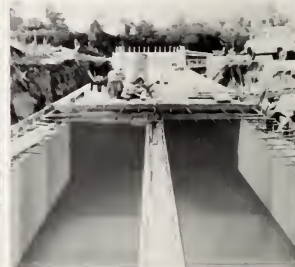
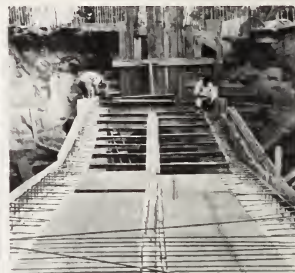


A number of improvements and additions were constructed: new raw sewage pumping and comminuting station, grit removal and chlorination equipment, two more primary and two additional final settling tanks, aeration tank equipment to double present efficiency, a second digestion tank and control building. Filtering media and underdrains in the sludge beds were replaced, the main control buildings revamped and modernized, and a complete laboratory installed.

Cover: Secondary wastewater treatment plant, expanded from 0.75 MGD to 2.0 MGD.

1. Remodeled control building.
2. Digesters and lift station.
3. Primary settling, aeration, and final settling tanks.
4. Grinding, grit removal, and lift station.
5. Complete laboratory in control building.
6. New 8" to 78" sewers include standard circular pipe and a twin-cell box.

Total project costs were \$2.7 million. To assure continued good operation of this facility, the Auburn City Council had HNTB prepare sound management guidelines, providing for regular reporting by the superintendent to the council, and interpretive management criteria for the council to evaluate and control operation.

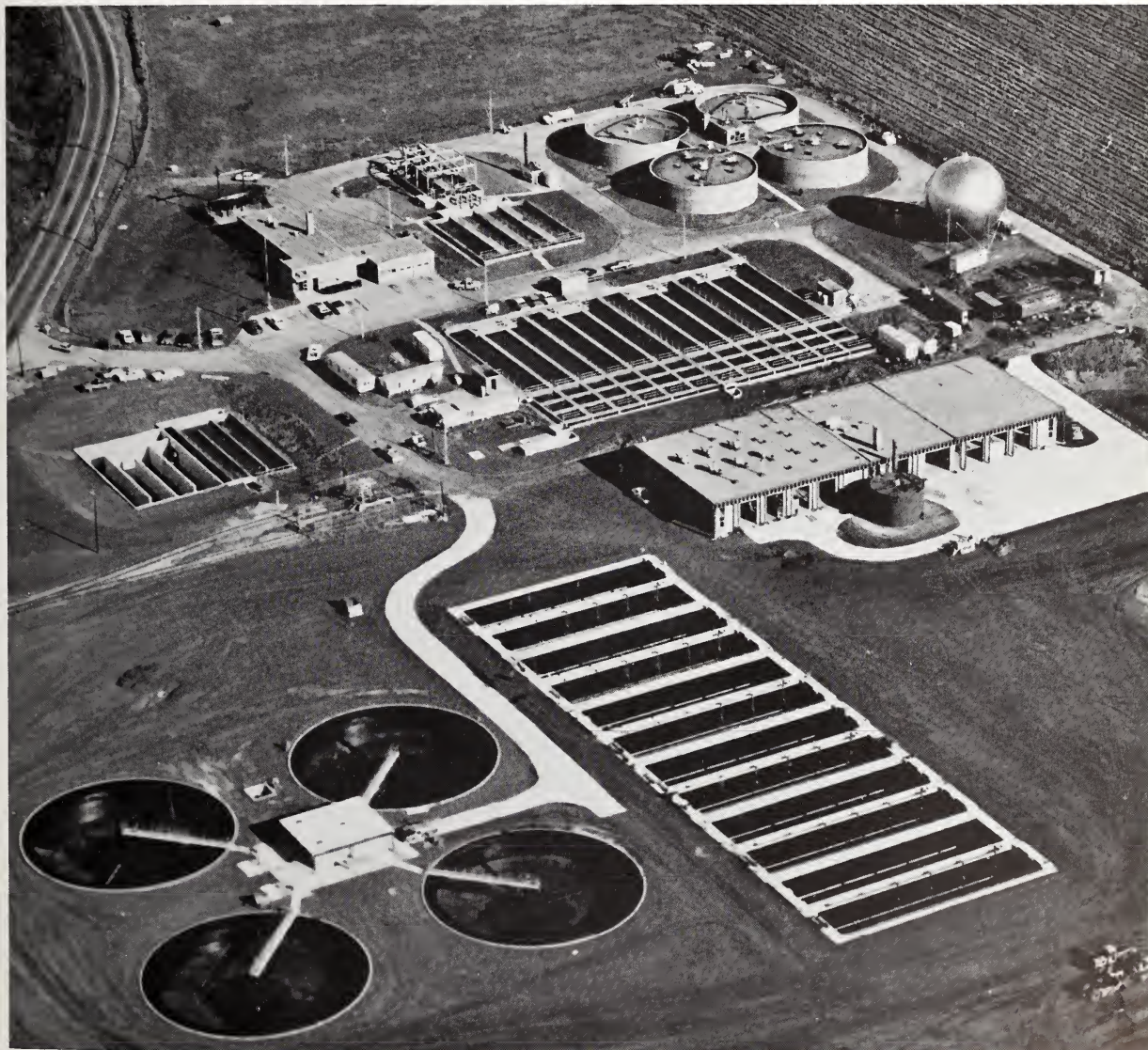


Wastewater Treatment Plant Terre Haute, Indiana

Client: City of Terre Haute

HNTB Services:

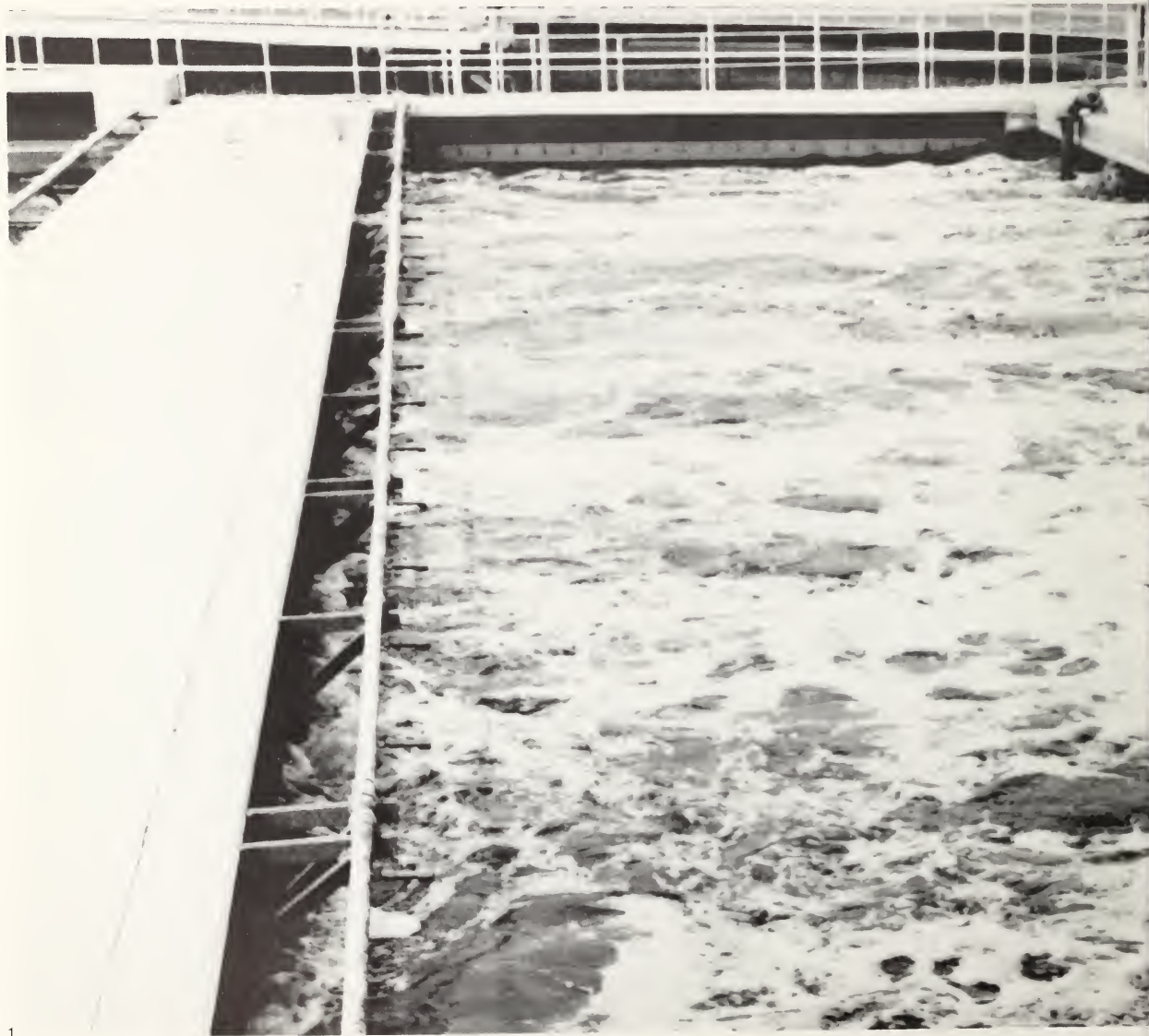
- Develop flow projections
- Design secondary treatment facilities
- Estimate capital investment and annual operating costs
- Assist in filing for state and federal aid
- Prepare operations and maintenance manuals



Terre Haute's original 20 MGD facility, put into operation in 1959, provided primary treatment and effluent chlorination prior to discharge to the Wabash River. When faced with the Water Quality Criteria and Plan for Implementation adopted in 1967 by the Indiana Stream Pollution Control Board, requiring the addition of secondary treatment, the city consulted HNTB's Indianapolis office.

Before plant design could be undertaken, needed capacity had to be determined. Average daily flow for 1968 had been 12.25 MGD,

but several more industries would be connecting since they were no longer allowed to discharge wastes directly to receiving waters. Trunk and interceptor sanitary sewers, a \$5,565,000 project designed by HNTB and under construction at the time, would provide service to such previously unsewered outlying areas as Rose Hulman Institute of Technology, Glenn Home for Children, the airport, the Town of Seelyville, and several subdivisions. Local extensions proposed within the city would provide sewers for about 18,000 previously unserved residents as well as a federal penitentiary at

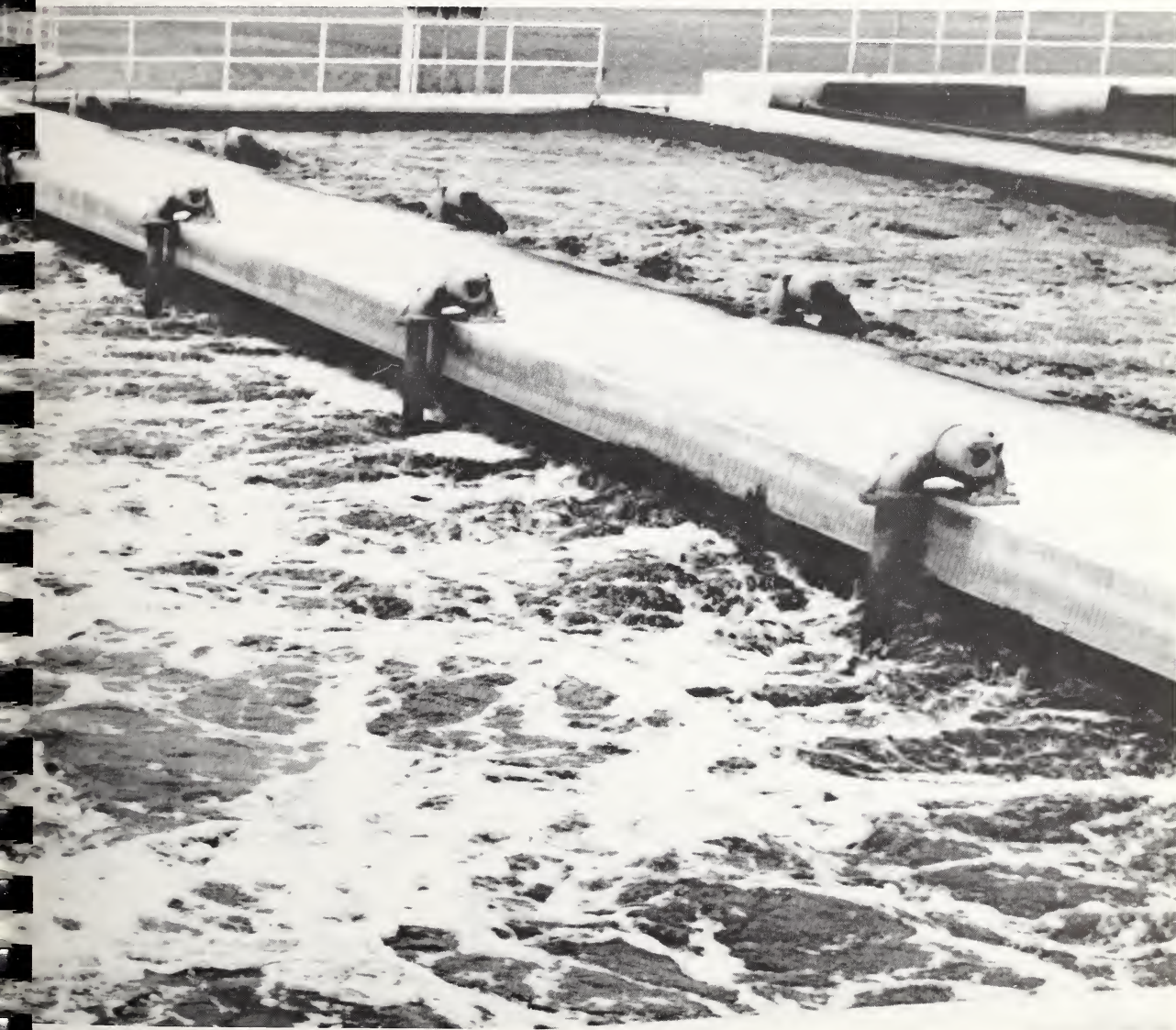


Terre Haute. An appropriate allowance for growth was added to the flow anticipated from these new customers, producing a design requirement of 24 MGD (million gallons per day).

With slight modifications, such as the addition of comminutors (grinding devices) between the grit and the pre-aeration tank, the existing primary treatment plant could handle the design flow. Secondary treatment additions included installation of aeration tanks and clarifiers, and a large blower building where equipment

was housed to produce air for the aeration process.

Among other additions were provisions for treatment of raw and digested sludge through the wet-air oxidation process, and dewatering of the conditioned sludge through a battery of vacuum filters. A large 50-foot diameter storage sphere was also installed, permitting the collection and utilization of methane gas produced by the sludge digestion process.



Construction cost of the treatment plant additions was nearly \$5,575,000. To qualify for federal funds, the City of Terre Haute had to file final plans and specifications by September 15, 1969, giving HNTB less than three months from authorization by the board of public works, to submit plans and specifications. The project immediately became top priority, the filing deadline was met, and the city received a federal grant of \$2,376,000. With another

grant of \$1,080,000 from Indiana, Terre Haute proceeded to let bids and issue revenue bonds, allowing them to put the new facilities into operation in 1972.

Cover: Aerial of Terre Haute wastewater treatment plant.

1. Diffused air multi-pass aeration tank.
2. Peripheral flow secondary clarifier.
3. Chlorine contact tank.
4. 50-foot diameter methane gas storage sphere.



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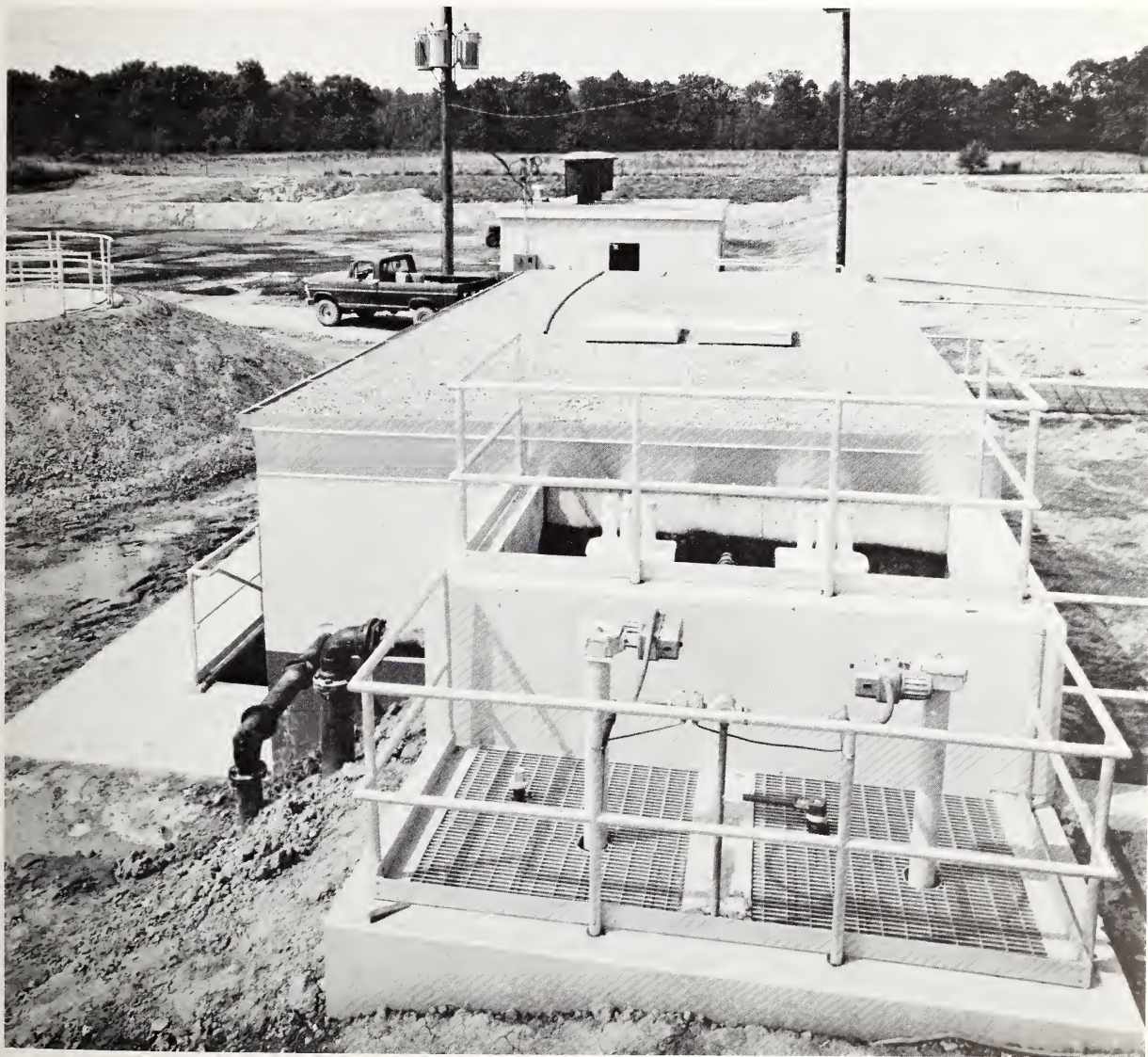
Industrial Waste Treatment

Auburn, Indiana

Client: County Line Cheese Company

HNTB Services:

Study of existing wastewater disposal system
Identification of wastewater sources and characteristics
Analysis of treatment alternatives
Design of treatment facilities



Despite a history of continuous updating of its disposal system to comply with water quality standards and recommendations of the Indiana State Board of Health, County Line Cheese Company still fell short of meeting stringent effluent requirements requested by the Indiana Stream Pollution Control Board.

Wastewater flows vary from 50,000 to 100,000 gallons per day. Like most dairy wastes, County Line's were high in dissolved organic matter, but laboratory tests showed them to be amenable to aerobic treatment. Wastewater from the whey plant could cause problems in an aerobic system, however, as it was found to be extremely variable in BOD (Biochemical Oxygen Demand), solids, and pH (acidity or alkalinity). Further, the manufacturing process was discharging about 75 pounds of phosphorous per day, 75% derived from cleaning compounds used in the whey plant.

Before examining treatment alternatives, HNTB established several operating criteria for the system: reduction of BOD and suspended solids to less than 10 mg/l; 80% removal of phosphorous; capability of treating wastewater with fluctuating characteristics and controlling wastes from the whey plant; operable by plant personnel; adaptability to changing plant conditions or effluent requirements.

A number of processes were considered, but all except three were eliminated because of expense, difficulty to operate, or uncertain treatment results. Pretreatment was planned to stabilize whey plant wastes before they entered the main system. After analysis of three processes in relation to the criteria, activated sludge and anaerobic contact were rejected in favor of aerated lagoons.

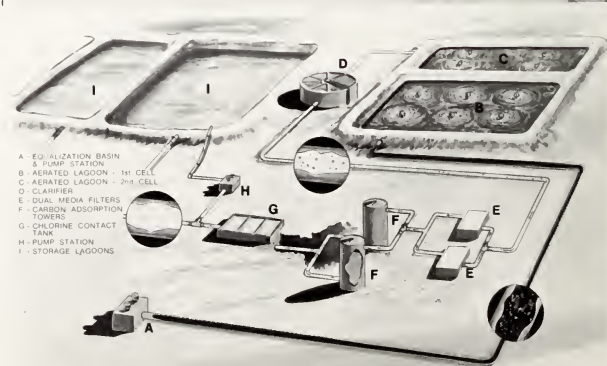
This process provided the greatest degree of flexibility, with removal of phosphorous and solids provided in a single step; also, effluent polishing by both dual media and activated carbon filters can be varied to achieve consistent results despite differences in the initial wastes. Construction cost would be lower since an existing lagoon could be used for storage of effluent prior to discharge to the receiving stream. Moreover, the system is relatively easy to maintain and operation is essentially automatic.

Construction cost of \$380,000 is considered quite economical compared with other processes treating similar loadings. More important, removal efficiency — 99.9% organic, 99.5% suspended solids, and 85% phosphorous — exceeds established control requirements, and County Line Cheese wastewater has been transformed from a strong pollutant to a clear nonobjectionable stream.

Cover: Portion of compact 100,000 GPD plant housing major treatment components.

1. Interior of plant showing carbon adsorption tower and control panel.

2. Flow diagram of waste treatment facilities.



Waterworks Improvements

Union City, Indiana

Client: City of Union City

HNTB Services:

Investigation of water supply, use, and quality

Forecast of needs

Design of system and treatment plant

Assistance with revenue bond prospectus



Cover: New 1.08 MGD water treatment plant and 250,000 gallon elevated storage tank.

1. High service pumps (300 GPM & 500 GPM), one equipped with auxiliary gasoline powered engine.
2. 3.036 MGD pressure sand filters, piping, valves, and backwash equipment.

When Union City, a community of 4100 on the east border of Indiana, experienced a 285% increase in water pumpage in a 15-year period while population rose only 35%, HNTB's Indianapolis office was asked to study and evaluate the waterworks facility and to recommend a means for securing an adequate supply of good quality water in the future.

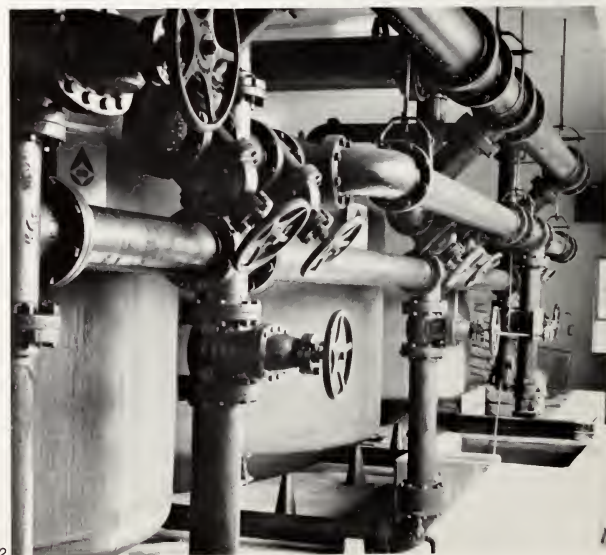
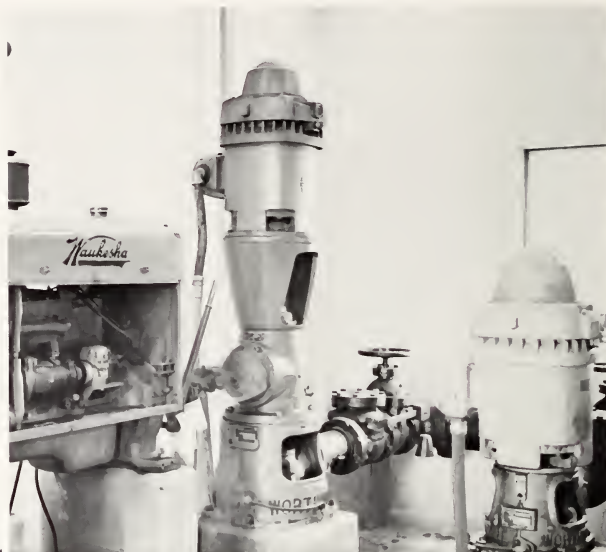
Investigation showed the high per capita pumpage and the phenomenal increase in total consumption were due to industrial growth in the area. All water from one well was used by a Westinghouse plant. A Coca Cola bottling plant and two laundries also were large users, and other plants being supplied included Hardy Division of Sheuer Globe Corporation and the Union City Body Company.

Water from the most recently developed well field had several objectionable characteristics: more than 2.0 mg/l (milligrams per liter) of iron in the form of ferrous bicarbonate, which in the presence of air turned into a yellow or reddish brown precipitate; and 0.2 mg/l of manganese bicarbonate which produced a disagreeable black and gray stain. The 60 mg/l of carbon dioxide, dissolved in the water as carbonic acid, would be quite corrosive to distribution mains and building piping.

Once Union City's particular water quality and supply problems were defined, HNTB engineers set about designing a system to meet present and future needs. Allowing for a population of 5200 in 20 years and greater domestic consumption, a 75% rise in water use was forecast. The increase would be even higher if another industry moved to Union City or an existing one expanded. Further, Union City was just about meeting fire flow standards established by the National Board of Underwriters, and with any growth, additional supply and storage would be needed.

Thus, the overall plan called for acquisition of sites for more wells within the newly proven aquifer; drilling of one or two wells; a second crosstown treatment facility; and addition of another elevated storage tank. A new treatment plant of 500 gpm capacity was specified on land just east of the new wells, where aeration, sedimentation, and pressure filtration were provided to reduce iron and manganese content to less than 0.1 mg/l and carbon dioxide to about 5 mg/l. Several mains with gate valves were also constructed to convey treated water from this plant to the distribution system. Hydrants were added to help meet fire flow standards.

Revenue bonds were issued in the amount of \$215,000, and with completion of the project, Union City was assured of a sufficient supply of potable water for years to come.



Wastewater Treatment Plant

Westboro-Hopkinton Service Area, Massachusetts

Client: Massachusetts Turnpike Authority

HNTB Services:

Projection of anticipated sewage volume

Selection of appropriate process

Design of treatment plant



Providing wastewater treatment at the Westboro-Hopkinton service area on the Massachusetts Turnpike presented two problems: a wide variation in projected sewage flows, anticipated to range from 50% to 160% of average conditions as a result of seasonal turnpike traffic patterns; also, lack of a nearby surface waterway where the treated effluent could be discharged.

After evaluating several types of treatment, HNTB selected the oxidation ditch process because of simplicity of operation, ease of maintenance, and reliability of performance. Low flows can be adequately treated, both hydraulically and biologically, yet ef-

iciency of the plant will not be upset by hydraulic shock loadings.

Raw sewage from the service area enters the treatment plant through a bar screen and comminutor where large solids, which could clog equipment, are retained or ground into smaller particles. The sewage then flows to one of two oxidation ditches, continuous concrete channels shaped in elongated ovals. As the sewage flows around the ditch, it is mixed with biological micro-organisms which, in the presence of oxygen, feed on organic pollutants. The mechanical brush-type rotor, which mixes the contents of the ditch and keeps them moving in a race-track fashion, also acts as a surface





aerator. The plant operator can adjust the amount of oxygen input by varying the depth to which the rotor is immersed, and thereby maintain optimum efficiency of the process.

After about 24 hours of treatment, the mix is withdrawn from the ditch and flows to a clarifier where the biologically active solids, called activated sludge, settle out and are pumped back to the ditch to continue the self-sustaining process. Excess sludge which gradually accumulates is stored until periodically trucked away for disposal.

The liquid withdrawn from the clarifier is chlorinated to kill any



pathogenic bacteria, then sent to a chamber for distribution to any combination of four sand filter beds where the treated wastewater leaches into the ground. Instead of the conventional underground system which requires replacement or excavation and cleaning of the entire disposal field when it fails, a unique concept of interlocking precast concrete modules was used, with covers which can be removed for periodic cleaning of the filtration media.

A small laboratory building was provided where the plant operator can make daily tests to monitor plant efficiency and adjust equipment accordingly. Wide variations in flow can be accommodated by less

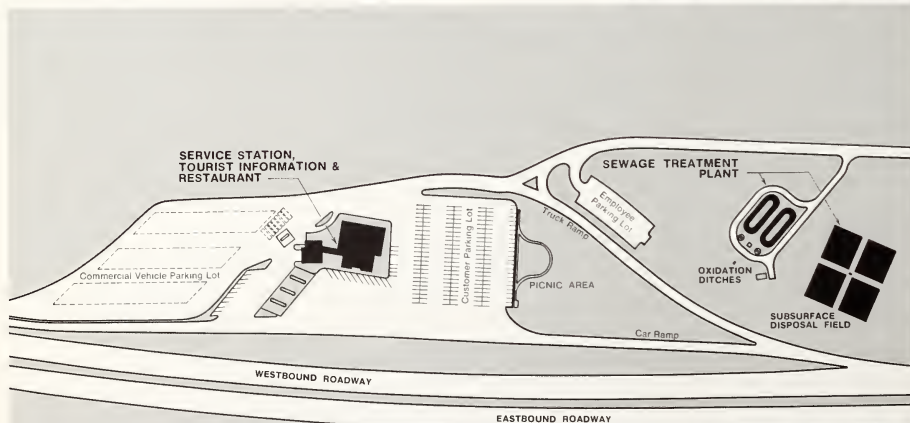
than maximum use of one ditch (capacity of each is 35,000 gallons), up to full utilization of both to treat 70,000 gallons of wastewater per day. Construction cost for the complete plant was about \$300,000.

Cover: Two oval-shaped oxidation ditches.

1. Sand filter beds with covers for easy access.
2. Service Station, restaurant, and tourist information.
3. Close-up of one oxidation ditch.
4. Site plan of service area.
5. Mechanical brush-type rotor mixes contents, keeps them moving, and serves as a surface aerator.



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Wastewater Disposal Facilities

Fairmount, Indiana

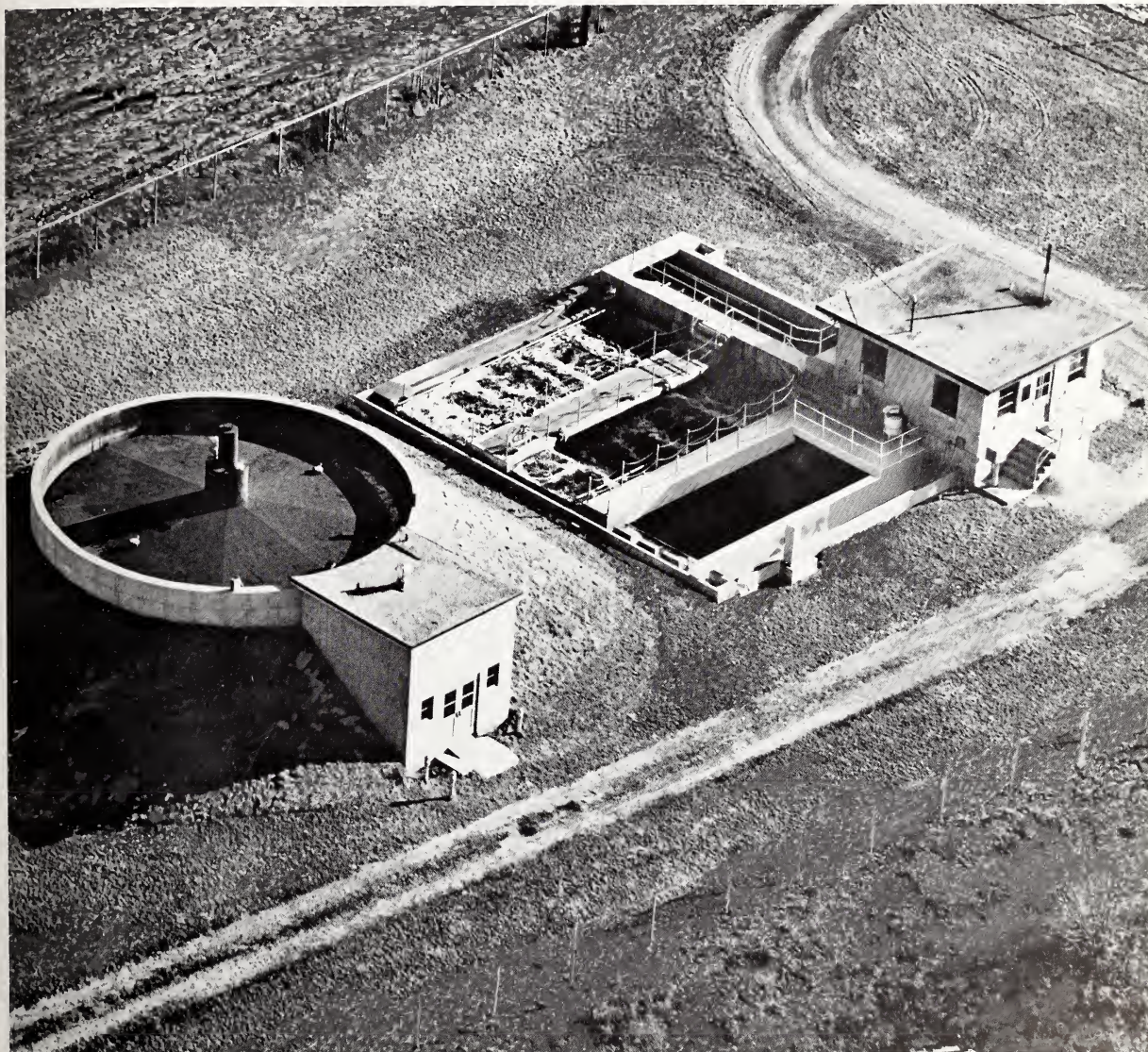
Client: Town of Fairmount

HNTB Services:

Identify wastewater problems

Design collection and treatment to alleviate problems

Assist with bond prospectus and application for federal aid

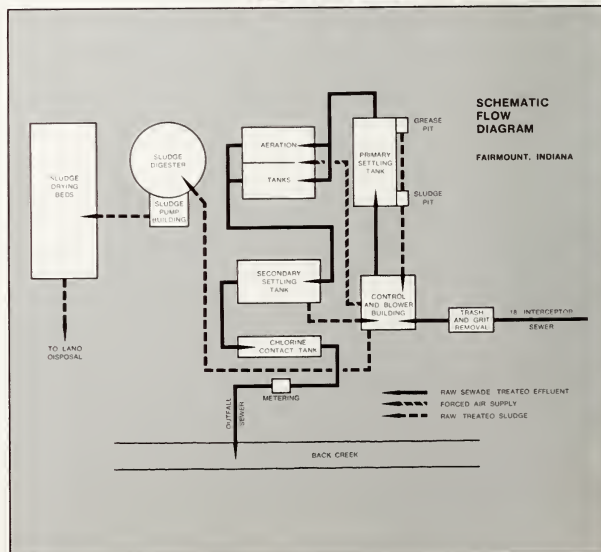


1. Primary tank and sludge draw off well.
2. Flow diagram for wastewater treatment process.

HNTB's overall design provided nearly five miles of new sanitary and storm relief sewers. A 12- to 18-inch interceptor, generally following the creek about 7700 feet, intercepts sanitary flow from the existing outfalls and conveys it to a new treatment plant. About 7000 feet of 10- to 15-inch replacement sewers in the southeast were of a size and depth to allow future extensions there. About 4700 feet of 12- to 24-inch pipe relieved trunk sewers along Adams, Jackson, and Madison Streets, thus alleviating flooding along Walnut Street. For present and future development and to replace several inadequate sewers, about 5400 feet of 8- to 12-inch trunk sewers were installed on the northeast and northwest sides of town.

The one-man simplified operation is on a nearly six-acre site on the east bank of Back Creek to which sewage flows by gravity. Plant equipment and piping are protected by a grit chamber and comminutor ahead of the raw sewage pumps. The flow is conveyed through a primary settling tank and two aeration units to a final settling tank; a 40-foot diameter unheated sludge digestion unit with floating cover receives raw and waste sludges. A 6000-square-foot drying bed completes conditioning of the sludge. Final effluent goes through a chlorination contact tank before discharge into Back Creek.

By committing themselves to a project costing \$497,000, the public-spirited citizens of Fairmount ended pollution of the watercourse which runs through the center of their town and reduced the incidence of waste-borne disease.



Wastewater Disposal Facilities Richmond, Indiana

Client: Sanitary District of Richmond, Indiana

HNTB Services:

Provide continuous service since 1947

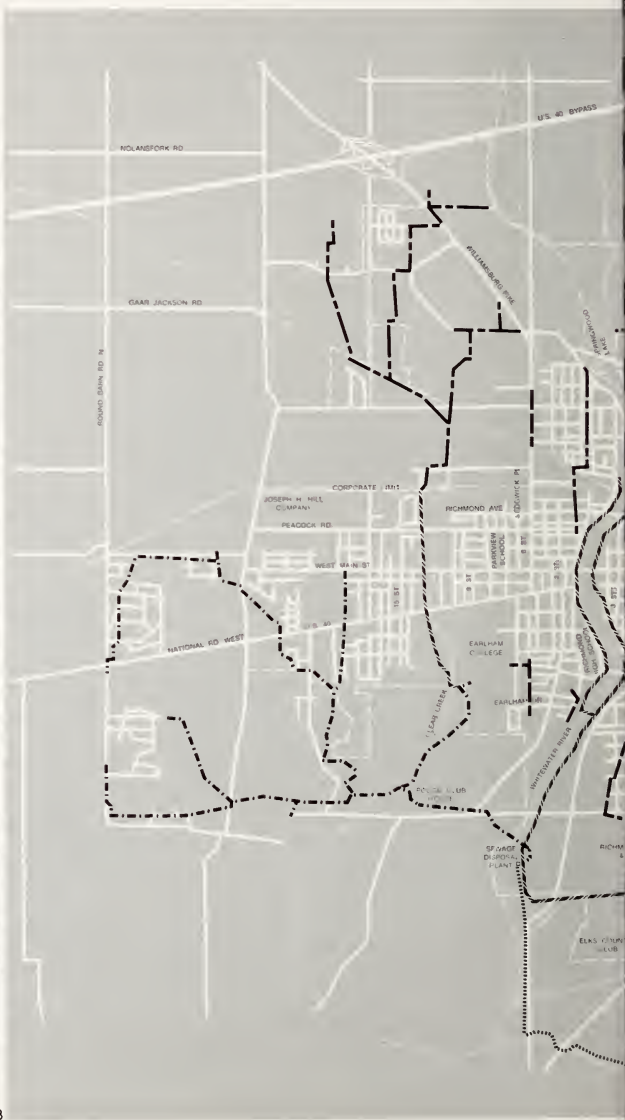
Design plant expansions and sewer extensions

Assist with applications for federal aid



Richmond's original 6.0 MGD wastewater treatment plant, constructed in 1936, is the second oldest activated sludge plant in Indiana. The district first called on HNTB for a general expansion to double plant capacity in 1947, then in the 1950's to design a maintenance garage for solid waste collection vehicles, to expand the administrative offices, and to improve raw sewage handling by adding mechanical raking and comminution facilities.

In the 1960's HNTB provided another 6.0 MGD in plant capacity by increasing aeration, clarifier, and sludge pumping capabilities. A maintenance garage and a second gas engine-driven air blower were also included. By 1970 more primary settlers, digesters, and chlorination facilities for a treatment capacity of 20.0 MGD were needed, as well as overall rehabilitation, updating of all electric lines, and complete renovation of the wash water supply system. A laboratory, added to the administration building at that time, is one of the best in the state, staffed by two full-time chemists who

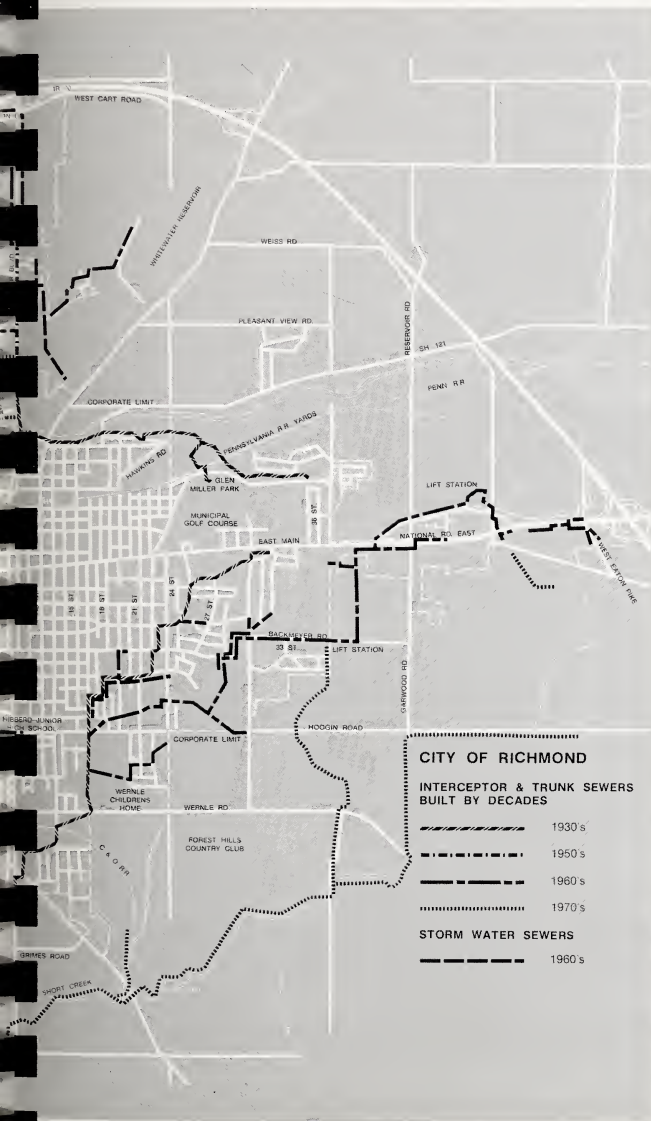


constantly test samples from the treatment plant, receiving stream, and various local industries.

Since the 1940's, HNTB has also been responsible for the master planning and design of more than 50 miles of interceptor and trunk sewers and about seven miles of storm sewers, utilizing various materials and installation techniques suited to each local condition. Currently, the firm is involved in the construction of a major new lift station and 36,300 feet of interceptor sewer and force main

along Short Creek to relieve overloaded sewers in the southeast part of the sanitary district.

Advanced waste treatment facilities to remove phosphorous and achieve a certain effluent quality are required by recently enacted state regulations on waste load allocations to receiving streams, and because of the new Brookville reservoir which is impounding water about 40 miles downstream. Present HNTB planning proposes that the activated sludge process be followed by rapid sand filtration,



supplemented by activated carbon adsorption. Preliminary estimates of project cost are about \$5,000,000, and a request for an EPA grant to prepare contract documents is pending.

In 1972, the Board of Sanitary Commissioners recognized their superintendent's 40 years of service to Richmond by naming the facility the Wm. Edwin Ross Wastewater Treatment Plant.

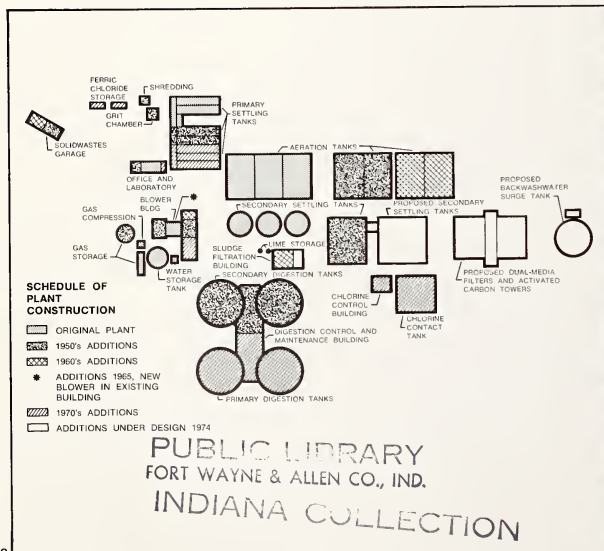
Cover: Seven aeration tanks, each with three units on a different level.

1. Seven primary settling tanks have a combined volume of 1,135,000 gallons.
2. Modern laboratory for checking every step in treatment.
3. Sewer improvements by decade since the 1930's.
4. Administration building housing staff offices, board room, laboratory, business office, and special storage areas.
5. One of many ongoing sewer improvements.
6. Gas from digesters is stored in a pressure sphere for use as required.
7. Comminutors grind incoming large solids, and inorganic materials are settled and screened by the grit remover.
- 8-9. Schematic and aerial view of wastewater treatment plant showing additions since 1951.



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In 1972, the... superintendent... facility the W...

Cover: Seven... units on a differ...

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2. Modern labo... in treatment...
3. Sewer impro... 1930's.
4. Administrative... board room... special stor...
5. One of man...
6. Gas from di... sphere for u...
7. Comminuto... and inorgan... screened by...
- 8-9. Schematic... treatment... 1951.

